JUNE 1951

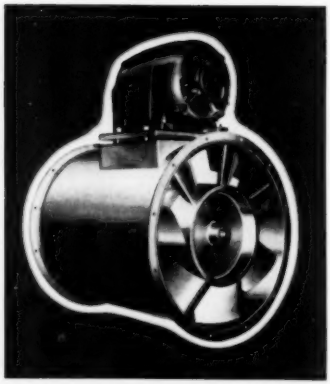
INDUSTRY AND POWER

For Executives and Engineers Responsible For The Engineered Plant Services

FEATURING REPORT ON INDUSTRIAL WASTE TREATMENT

State Laws • *Riparian Rights* • *Pollution Problems* • *Treating Methods*

the HARTZELL vaneaxial blower is *EASY* to install

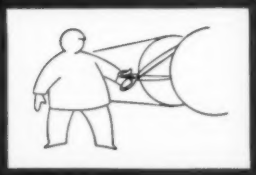


A POWERFUL BLOWER

efficient against very heavy pressures

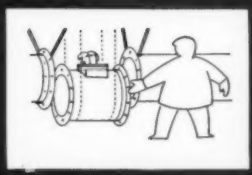
Maybe you didn't realize this: A single Hartzell 48" Vaneaxial Blower can move 71,100 CFM against a half-inch static pressure, consuming just 50 HP, or 41,100 CFM against *seven-and-a-half* inches, with 65.3 HP. That's air-moving power against pressure! So, you see, there's no need to put up with clumsy, power-wasting air-moving devices which require an engineering crew for installation and clutter up valuable floor space. Get the *complete* economy of Hartzell Vaneaxial Blower design and construction . . . economy which begins with purchase price and installation and saves your money year after year after year.

cut out a duct section same length as blower



bolt angle-iron flanges to duct ends

bolt the blower to the duct ends just installed, and brace duct flanges



And that's all — just make electrical connections and you're done!

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NO MATTER what the material you have to move—inside or outside your plant—it'll pay you to investigate conveyor belts. The G.T.M.—Goodyear Technical Man—can analyze your problems drawing on experience gained from successful installations throughout industry—match *your* problems with others to prove that conveyors can be the most economical cargo-handlers. And he can choose from a wide selection of belt constructions to specify the one that will give you the longest, most trouble-free service on your particular job. Get in touch with the G.T.M. today by calling your nearest Goodyear distributor, or writing Goodyear, Akron 16, Ohio.

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◀ Old-style chain conveyors outperformed by a Goodyear conveyor 3 to 11 Over 1,000 tons of fish per hour are carried into the processing plant of this fertilizer maker, at lower cost per ton than ever before.

Paper mills everywhere are turning to conveyors to handle logs, chips and other raw materials. Here, too, the G.T.M. has made appreciable savings by designing systems to replace former materials-handling systems, ▼ operate at lower cost.

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- Sanitary handling of foods in canneries
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GOODYEAR

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BURNS ALL THE FUEL— INCLUDING THE SMOKE
DIRTY SMOKY FIRE CAUSED BY INCOMPLETE COMBUSTION
CLEAN FIRE, COMPLETE COMBUSTION with TURBO-AIRE

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Cover Illustration

Mechanical clarifier at the River Raisin Plant reclaiming pulp fibers from paper-mill white water. Unit handles the waste water from two seven-cylinder paper-board machines. More specific details will be found on page 74.

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Trouble Tips on D C Motors 72
Thomas Trail
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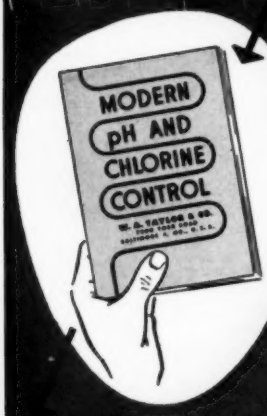

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Floating on Air

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Ozone is Tamed

● Valuable for deodorizing air, oxidizing wastes, bleaching and other uses, ozone produces extremely active oxygen as it decomposes. Unfortunately, the liquid form tends to detonate spontaneously and ozone is shipped in bulky highly-diluted gaseous form. Now, a method of handling the liquid by "removing certain thermal, mechanical, electrical and chemical sensitizing influences" is announced by Illinois Institute of Technology and Air Reduction Co., Inc.

$30,000,000 Laboratories

● At the new DuPont Experimental Station laboratories, the following developments which may affect plant operations were demonstrated:

New Coating Process

● The high temperature insulation, "Teflon," cannot be extruded on wire rapidly compared with other thermoplastics. Being developed is a process for rolling the powdered plastic onto wire as it passes through grooved rolls, then baking to fuse the particles. With cheaper heat and chemical resistant insulation for wire as a result, smaller low-cost motors are in prospect.

Sand for Lubricants

● It's not sabotage. A sand-derived material, GS-199S silica, is being studied as a thickener of oil in making grease. One of many types of silica, it occurs as balls less than a millionth of an inch in diameter. Special treatment, which also makes it float on water, keeps it dispersed in grease at high temperatures. Besides retaining stiffness under unusual heat conditions, silica grease resists water and mechanical breakdown. Colloidal silica has already been used to take the slip out of floor wax.

Pocket Laboratory

● Pre-measured reagents in small bottles, a hypodermic needle and a rapid-weighing analytical balance are all that are needed for many chemical determinations. The bottles, which have soft pressure-sealed caps and hold exact quantity of reagent (with indicator) for each determination, can be prepared in wholesale lots. Sample is added through cap with the hypodermic needle until reaction is complete. Reweighing bottle then permits rapid calculation of results. Highly trained men are not required, and many plant analyses, as on effluents, could be quickly and easily made.

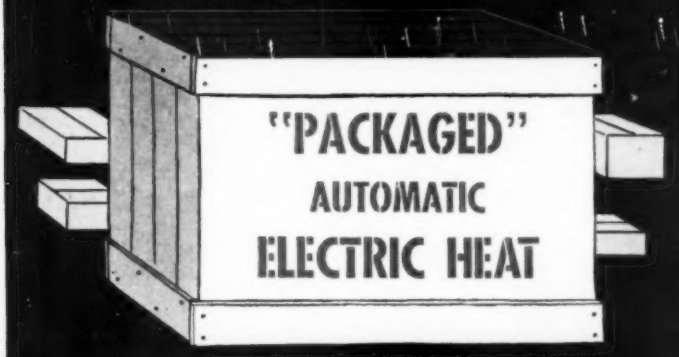
High-Pressure Quirks

● In high pressure processes, liquids may freeze at room temperature. Consequences could be serious when it occurs in pumps or pipelines. Apparatus for determining freezing pressure was demonstrated on cyclohexane, used in making nylon, which froze at 6,000 psi. Precise determinations could be made at pressures twice as great.

● Steel tubing, with a hole about the size of a human hair was shown. Pressure of 7,500 psi is sufficient to make medium oil flow freely through about a yard of the tubing.

● Other apparatus, able to reach 200,000 psi in volumes of practical significance, is used to test materials, usually steel cylinders similar to tubing for chemical plant use. Some burst, some bulge or otherwise fail. Ability to withstand pressure in terms of wall thickness and material is found. Result—installations will not need to be made of heavier and costlier materials because of lack of design data for high pressure process equipment.

CHROMALOX



combining Heater and Thermostat in one unit

ready to go on your Jobs!

● CHROMALOX 'Packaged' Electric Heaters are ideal as permanent or portable heat sources in tanks, drums, process kettles and other containers. With CHROMALOX Heaters you can heat accurately and maintain the temperature of degreasing, cleaning, pickling and plating baths. You can melt greases, asphalt and similar viscous fluids. CHROMALOX Units may be had in the types, sizes and wattages required to efficiently do your heating jobs. They are available with sheaths of copper, stainless steel, alloy and lead for resisting the corrosive actions of the solutions you are using.

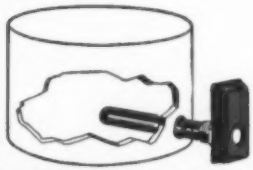
Nation-wide engineering service for on-the-job assistance and recommendations. Write, wire or phone for the name of the Chromalox Engineering Representative serving you.

CHROMALOX

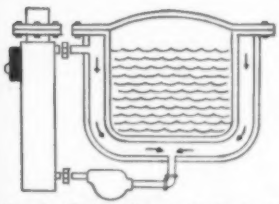
Electric Heat for Modern Industry

Variety and Versatility to fit your Needs Exactly

Chromalox Immersion Heaters with built-in thermostats for portable or permanent use. Drawing illustrates Immersion Units, equipped with sludge-legs, installed over the side of the tank for direct heating. Available in various metal sheaths to resist the corrosive action of the liquid compounds.



Compact, thermostatically controlled, screw-in type Chromalox Immersion Unit is easily installed in smaller tanks and other containers. Thermostat range is 100° to 180° F.



Chromalox Circulation Heaters give accurate, controlled heat up to 750° F. for heating Dowtherm, Aroclor or heat transfer oils. Other uses include water heating applications such as steam boilers and accumulators, kettles, tanks and processing equipment, preheating fuel oils, heating air, nitrogen and other gases, drying steam, plastic powders, etc.

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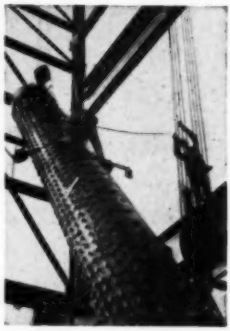
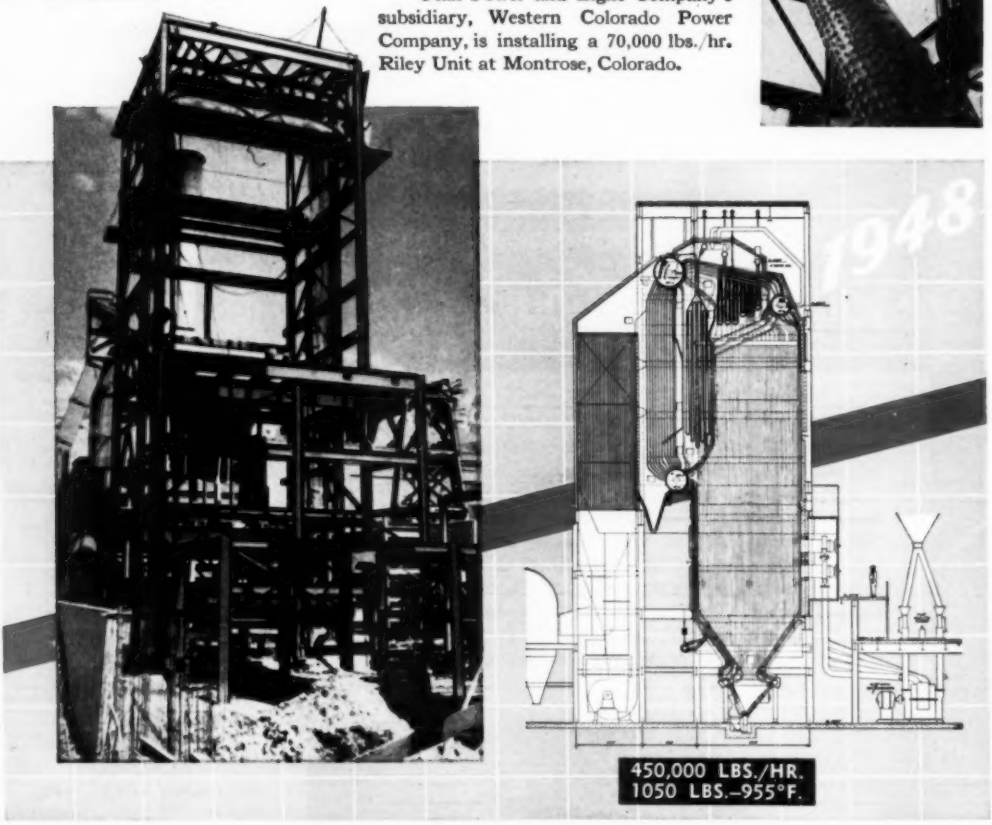
Pattern of Progress at Utah Power

Utah Power and Light Company has instituted a program tremendously increasing its power producing capacity. While their Pattern of Progress includes expansion of many facilities other than their steam power plants, it is an all Riley performance insofar as new steam generating units are concerned.

Utah Power and Light Company installed its first Riley Unit at its Orem Station in 1948—a 450,000 lbs./hr. Riley Unit. Utah Power and Light Company is now installing a 620,000 lbs./hr. 1500 psig 955°F. Riley Unit at its New Jordan Station, and has ordered a 575,000 lbs./hr. 1700 psig 1000°F. reheat Riley Unit to be placed in operation in 1952.

Utah Power and Light Company's subsidiary, Western Colorado Power Company, is installing a 70,000 lbs./hr. Riley Unit at Montrose, Colorado.





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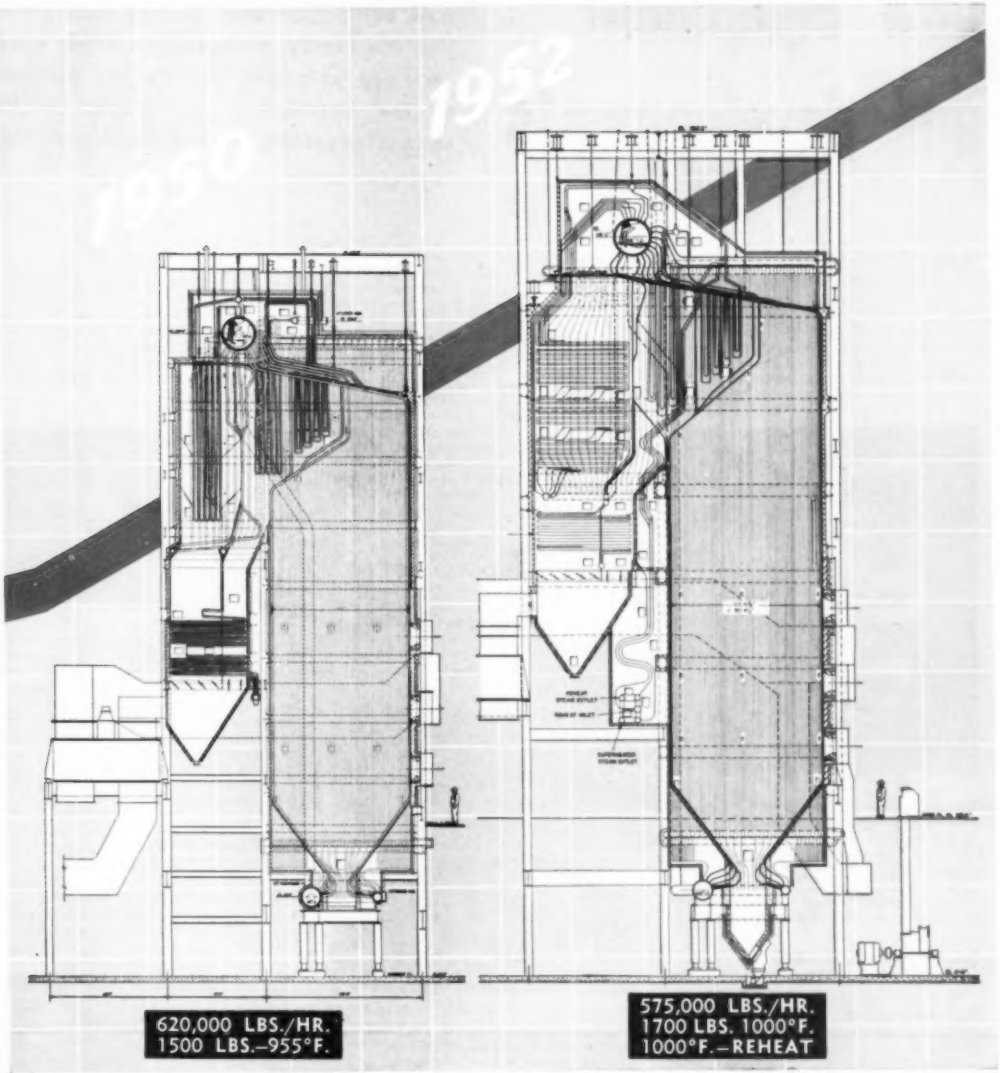

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new equipment and developments

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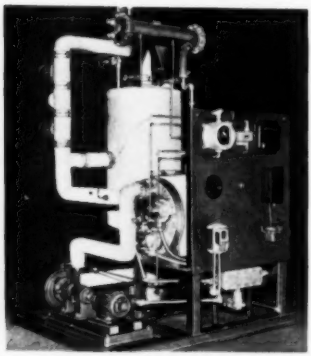
1—ELECTRIC HEATERS ARE PACKAGED

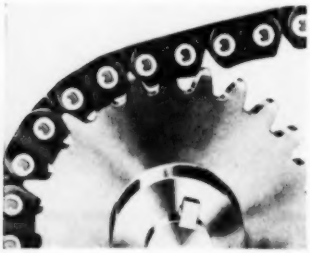
A standard line of electrically heated Dowtherm heat transfer units has been developed by Struthers Wells Corp. that come complete with instruments, piping, insulation and other accessories. These units are ready for immediate use upon delivery. Capacities range from 100,000 to 500,000



Btu per hr, and the heaters have a temperature range to about 750 F using Dowtherm as a liquid or vapor medium. The entire unit may be base mounted at the factory or supplied with all essential equipment for field mounting. This heat transfer unit includes a special heating element, designed to eliminate thermal breakdown or coking.

2—CHAIN DRIVE HAS SMOOTH OPERATION

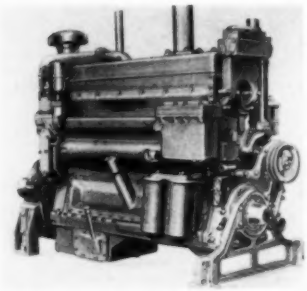
A power transmission chain drive has been developed by the Morse Chain Co., called the Morse Hy-Vo (high velocity) chain drive. It provides—for the first time—a power transmitting medium that combines dependability of a gear drive with



the smoothness and lack of vibration of a belt. It makes possible single drive unit capable of transmitting as much as 5000 hp at linear speeds up to 6500 fpm, or rotative speeds up to 3600 rpm. The unit has a chain-and-sprocket engagement that eliminates bumping, slapping, jerking action and vibration. These sprockets resemble involute gears, having curved involute teeth, which engage the links with conjugate action. A compensating rocking joint eliminates slippage and wear. This joint shifts the pitch-line automatically, engaging the involute sprocket teeth in such a way that the chain follows a path tangent to the sprocket pitch line. The result is a smooth, almost vibrationless action.

3—INDUSTRIAL DIESEL HAS OIL COOLED PISTONS

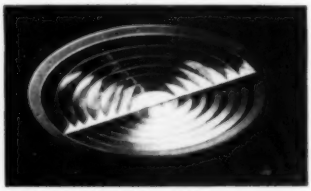
Industrial diesel engines, D337 and D326, are scheduled for production sometime mid-year in 1951, according to Caterpillar Tractor Co. One new feature on the two models is the fuel system with pumps mounted adjacent to the cylinders they serve. This



results in standard, identical, short fuel lines for each cylinder. Oil cooled pistons are used that have an iron band cast integrally for the upper ring. They are cooled by an oil stream sprayed from a nozzle that is solidly attached to the engine block. Since this spray lubricates the piston pin, as well as cooling the piston, oil grooves are not required in the connecting rod. Fine filtration elements handle the full flow of oil to the engine system, and oil passageways are protected from dirt and foreign material. The rated horsepower for these engines (without fans) is: D337—180 at 1600 rpm and D326—125 hp at 1600 rpm.

4—AIR DIFFUSER FOR HIGH PRESSURE

High-pressure, aspirating air diffusers are now available from Anemostat Corp. of America. The units come in three sizes. No. 15 has a neck area of 32.81 sq in. and is rated 80 to 170 cfm primary air capacity at 0.5 to 2.35 wg sp. No. 17½ has a neck area of 42.75 sq in. and is rated 105 to 222 cfm at 0.68 to 3.1 wg. No. 20 has a neck area of 60 sq in. and is rated 145 to 312 cfm at 0.7 to 3.2 wg. Adaptable for air distribution systems that carry air at velocities up to 5000 fpm and static pressures up to 6



in. wg. High temperature differentials (up to 30F) can be handled, and temperature difference between primary air and ambient of room air is limited only by dew point to avoid condensation. Air volume can be manually or automatically controlled. Control valve and sound trap are capable of attonuating duct noise from 90 decibels on the high pressure side to 40 decibels on the low pressure side at a background sound level of 30 decibels.

5—PUMP SPRAYS HEAVY MATERIALS

Spray gun spurting, which often projects a glob of heavy industrial material upon the coated surface, is completely eliminated by the new Graco Co., Inc., pump. This air-operated, high volume unit is equipped

with a device called the Evenflo, which positively prevents spurting. Now surfaces can be coated evenly to meet rigid specifications. These units can supply industrial material through hoses for spray gun, pole gun or

(Continued on page 12)

Nalco

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BOILER WATER (AND PROCESS) ANTIFOAMS

☆ **CLEAN STEAM** results when you use Nalco Antifoams . . . No carry-over . . . No scaling of traps or valves.

☆ **LESS BLOWDOWN** with Nalco Antifoams because much higher dissolved solids concentration can be safely carried.

☆ **PROCESS USES** of Nalco Antifoams are saving time, trouble, money in more and more plants . . . Do your Process Engineers a favor by passing this on to them—Nalco Antifoams react in much the same way in many process liquids as they do in boiler water!

Nalco Antifoams are the chemicals which can bring you this modern economy. They are fed directly into feedwater or boilers with other water treatment compounds, or independently, in dosages of *only 5 to 8 parts per million!*

The use of Nalco Antifoams has consistently enabled boiler operators to double, triple or even quadruple previous concentration limits . . . and at the same time produce cleaner steam.

Tests in an operating 70,000 lb./hr. boiler (see water analysis below), with 8 p.p.m. Nalco antifoam, failed to produce carryover when dissolved solids concentration *exceeded 25,000 p.p.m.!*

If your antifoam performance is less than you can get with Nalco Antifoams, act now to cut operating costs.

TEST BOILER WATER ANALYSIS at beginning of no-blowdown run, in p.p.m.: H-O, P-720, M.O.-750, Cl-900, SO_4-1420, PO_4-40, DS-3350, S.S.-Trace.

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Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario.

THE Nalco SYSTEM

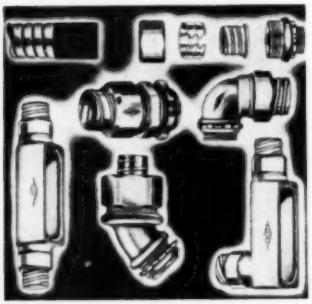
Serving Industry through Practical Applied Science

(Continued from page 10)

extrusion gun application. Extra high volume pumps operate within a broad air pressure range (from 20 to 175 psi), can be powered by air compressors with either large or small output capacities. Rust and corrosion preventives, calking compounds, adhesives, sound deadeners, roofing materials, undercoaters and many other industrial materials can be pumped.

6—LIQUID-TIGHT FITTINGS FOR FLEXIBLE CONDUIT

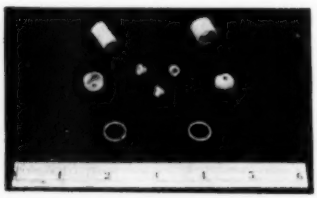
Vap-Oil-Tite, available from Simplet Electric Co., is a liquid and vapor tight, positive ground fitting used to connect synthetic covered flexible metallic conduit. It is recommended where water, oil, chemi-



cals, grease, dirt and corrosive fumes are present. The bushing or ferrule is threaded into the spiral between the convolutions of metal core of the conduit, thus insuring a fool-proof, positive ground. This bushing also makes it unnecessary to burr the ends of the metal core after cutting because of a collar that covers the rough edges. Bodies are furnished in sizes from 3/8 to 2 in.

7—CONTINUOUSLY EXTRUDED TEFLON RODS AVAILABLE

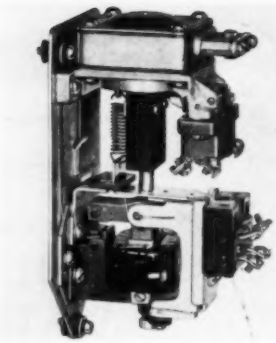
Continuous extrusion of Teflon rod and tubing in diameters up to 2 in. is announced by The Polymer Corp. Rods in diameters of 1/16 through 2 in. and tubing from 3/8



through 5 in. ID are being produced on commercial scale. Larger sizes can be made to special order. Typical parts made of Teflon rod and tubing include insulators for electronic equipment, valve and pump packing and gaskets.

8—PNEUMATIC RELAY HAS 0.2 SEC TO 3 MIN RANGE

Square D Company's type R pneumatic timing relay has an invertible magnet that increases its adaptability to conveyer sys-



tems and similar operations. Depending upon the position of the actuating magnet, contacts operate with delay either after energization or after de-energization of the magnet. No extra parts are needed to convert, and a screwdriver is the only tool required. Timing range is conveniently adjustable from 0.2 sec to 3 min. Accuracy is within 10 per cent and is independent of normal variations in voltage, ambient temperature or atmospheric pressure. Silver-to-silver, snap action contacts have pilot duty ratings up to 600 v, a-c or d-c.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

9—PLUG VALVES WORM AND GEAR OPERATED

Worm and gear operated valves have been added to the line of lubricated plug valves manufactured by Homestead Valve Mfg. Co. These valves have the patented Self-Seald construction characteristic of all Homestead-Reiser valves; port area equivalent to 100 per cent of the area of standard pipe; cast in semi-steel; and made in 8, 10 and 12 in. sizes. The valves will soon be

available in cast-steel, full-port type and in venturi type sizes up to 14 in. The venturi-type valves will have face to face dimensions identical to those of like-sized series 15 wedge gate valves.

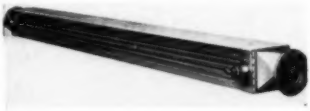
10—SERVICER EASY TO OPERATE

Atlas Industrial Corp. announces a Marquee Servicer made to reach a 22 ft ceiling. It comes in one piece with no erection required, no loose parts. This safe dependable

servicer can be easily rolled and raised. The unit is compact and small enough to pass through any ordinary doorway. The all welded steel construction means absolute safety, outrigger brace prevents tilting or rolling. Ideal for overhead maintenance, painting, lighting and cleaning.

11—HEAT EXCHANGER EASILY ASSEMBLED

Modine Mfg. Co. has announced the development of a new plate type heat exchanger. It incorporates interlocked channel type fins with special embossings or interrupted surfaces. The design provides un-



usually high concentration of surface for low weight and volume. Surface area ranges from 250 to 300 sq ft per cu ft permitting substantial cost savings over conventional heat exchangers. These units were designed for easy assembly into blocks to accommodate a wide range of capacity requirements.

12—SERVICE PUMP STEAM DRIVEN

The latest addition to the Byron Jackson Co., Pump Div., line is a combination of standard TL Bilton pump sizes with one of two Moon steam turbines. The two steam

(Continued on page 16)

In the Interest of Water Conditioning

The Betz Indicator

It has always been the policy of The Betz Organization to publish and distribute informative literature pertaining to the many-faceted subject of industrial water conditioning. As new developments occur, or as established practices are improved upon, we publicize the information.

Typical of our many publications is The *BETZ INDICATOR*, which has been issued monthly—without interruption—for 19 years. Each issue features one or more topics concerned with water conditioning or water analyses, in addition to other articles of universal interest to the engineer.

With a circulation of more than 19,000, The *BETZ INDICATOR* is mailed to power engineers, plant superintendents, chemists and others interested in the vitally important subject of water conditioning in every state of the Union, every province in Canada, and to many foreign countries. If you, too, would like to receive it without cost or obligation, simply send us your request on your company letterhead.

W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Pa.
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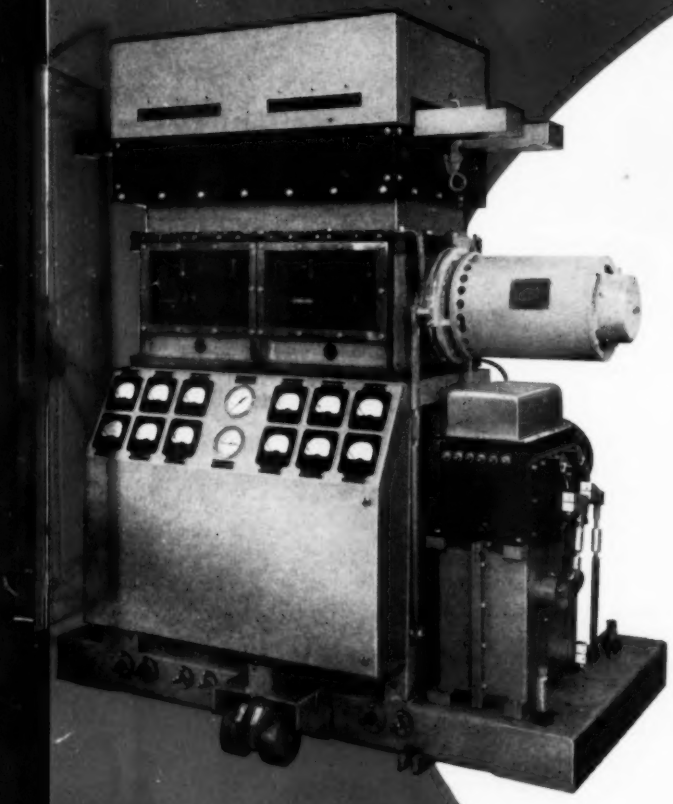
BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

SEVEN I-T-E MECHANICAL RECTIFIERS



The heart of the I-T-E Mechanical Rectifier — one 10,000 ampere contact mechanism with contacts enclosed in box on top. Driving eccentric can be seen through windows. At right is the drive motor, with the automatic regulator below. The 12 indicating instruments show the timing of each contact while the mechanism is running and carrying load.

I-T-E Mechanical Rectifiers are available in the following ratings: 4,000 — 5,000 — 6,000 — 7,000 — 8,000 — 9,000 — and 10,000 amperes, in any voltage from 50 to 400 volts d-c. Primary voltages: 2,300 to 46,000 three-phase a-c.

Two years ago, Buffalo Electro-Chemical Company, Inc., Buffalo, N. Y., installed two I-T-E Mechanical Rectifiers, the first mechanical rectification units ever built in this country.

This pioneering spirit of Buffalo Electro-Chemical's progressive management justified itself to the extent that at present I-T-E has orders for five more Mechanical Rectifiers—to augment Buffalo's current modernization program.

I-T-E's Mechanical Rectifier has benefited Buffalo Electro-Chemical—and can handle your low voltage power conversion requirements more effectively.

1 **HIGHER EFFICIENCY**—actually 96% or more in the 100 to 400 volt range, because silver to silver contact minimizes voltage drop in rectifying element.

2 **SPACE SAVINGS** — extremely compact grouping of all operating and protective apparatus.

3 **EASY, LOW-COST INSTALLATION**—unit assembly at factory allows "packaged" delivery, easy installation. No special structural foundations are required; no crane service is needed in rectifier room.

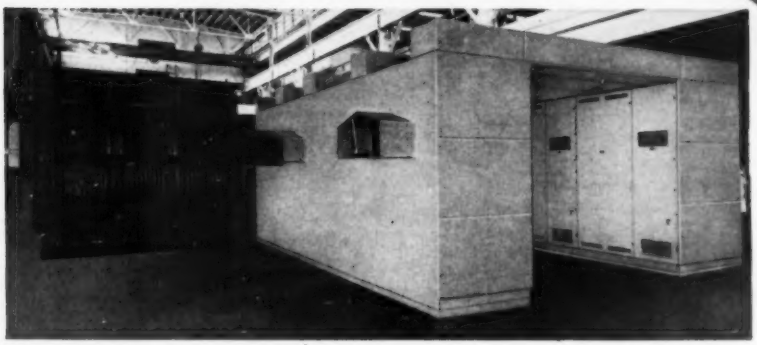
4 **SIMPLE, LOW-COST MAINTENANCE**—maintenance is almost entirely mechanical, requiring no trained personnel, complicated tools or instruments for servicing.

5 **SIMPLE OPERATION**—push-button starting without preliminary warm-up of any kind; immediate connection to load.

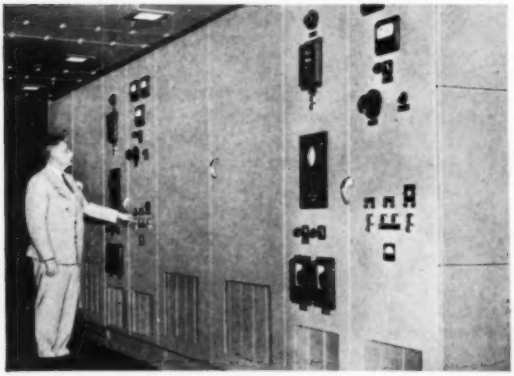
6 **SAFETY**—use of low voltage in your cell room increases safety to operating personnel and equipment.

FOR BUFFALO ELECTRO-CHEMICAL

TYPICAL I-T-E MECHANICAL RECTIFIER ARRANGEMENTS



Factory assembly of two 10,000 ampere units with outdoor transformer (only one of two shown), throat connection through wall rectifier enclosure, operating aisle and d-c switchgear compartments.



Close-up of control and instrument panel. The thoroughness of I-T-E engineering is illustrated by the overhead lights, furnished with the installation and assuring proper illumination of the control panel.

View looking through operating aisle. Rectifier enclosure and control panel to left, d-c switchgear to right, interconnecting d-c bus overhead.

I-T-E

R&IE

MECHANICAL RECTIFIERS

I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Canadian Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

MECHANICAL RECTIFIERS • SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • RESISTORS • SPECIAL PRODUCTS

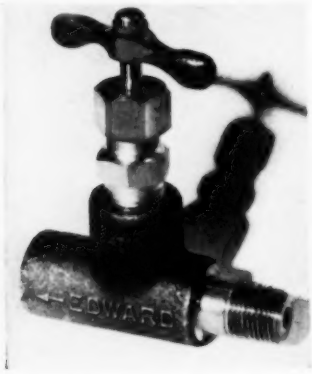
(Continued from page 12)

turbines have the same shaft extension and rabbitt fit so that one standard connector and shaft sleeve is used with all pump and turbine combinations. Standard models are recommended for water supply, air conditioning, general liquid handling and for general purpose application for plants using

steam as their primary power and also emergency power. Pump sizes are 1-¼ to 3 in. Capacities range to 600 gpm with heads to 320 ft. Standard construction is with packing, but a type "L" mechanical seal can be supplied for discharge pressures up to 75 psi and a type "U" seal for discharge pressures above 75 psi.

13—FORGED STEEL GAGE VALVE HAS MALE INLET

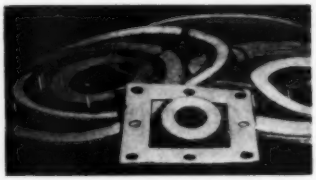
Edward Valves, Inc. now offers a male inlet and female outlet in their forged steel gage valve series. The gage valve requires no nipples—as for example, when hooking up pressure gages to pressure tubing or casing, because the male inlet basical-



ly serves the same purpose as a nipple. The male inlet is an integral part of the forged steel valve body offering greater strength and soundness. The wall thickness of the male inlet is extra heavy for high pressures and provides greater protection against breaking off or rupturing. Ratings are 4000 psi at 150 F or 600 psi at 750 F.

14—ASBESTOS GASKET HAS MANY APPLICATIONS

Asbestos gaskets, manufactured by Lawton H. Parsons, are designed to give service where surfaces are rough or uneven and subject to considerable expansion and contraction. These gaskets can be used to hold steam, air, water, ammonia and various other acid and alkali chemicals in storage tanks, dryers, locomotives, tank cars, boilers and locomotive service. Standard size flanges are 3/16 in. thick and 7/16 in. wide or larger. Inside diameters are from 2½ to 18



in. Special gaskets of larger sizes and square or either oval are made to order. Irregular shapes and bolt holes are supplied according to customer specifications.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

15—SOLENOID HOUSING IS EXPLOSION-PROOF

An explosion-proof solenoid housing for use on electrically operated pilot controlled valves has been announced by Ross Operating Valve Co. The cover, which can be used wherever fire and explosion hazards exist, is manufactured of cast-aluminum to Underwriters' Laboratory specifications, Class 1, Group D, air brake type. Provision is made for standard conduit connection. The explosion-proof solenoid cover may be used with

this company's ¼ to 1-1/4 in. size pilot operated straight-way, three-way, four-way and four-way five port models for single solenoid operation. The housing may also be used for double solenoid, momentary operation base mounted pilot controlled valves.

16—SEALING RING REDUCES WEAR

One-piece sealing rings—on which the sealing member is located on the inner side of the ring—are now available from the Double Seal Ring Co. The inner sealing

member extends the full width of the ring and has no top or bottom. It seals fully from both sides and cannot be installed upside down. These features make it ideal for use on single-groove, double-acting pistons in engines, compressors and pumps. Locked-in end will not protrude into openings in cylinder walls, and this greatly lessens danger of catching and clipping of ring ends in the cylinder ports of two-cycle engines. Undue wear on cylinder walls is eliminated in equipment that has very little or borderline lubrication or that is troubled by temporary failures of lubrication.

17—GASOLINE HAMMER HAS UNIQUE STARTER

Introduction of a portable gasoline hammer, that features greater portability and increased operating convenience, is announced by Barco Mfg. Co. These hammers are distinguished by a simplified arrangement of parts made possible by a highly compact ignition coil-vibrator-condenser assembly, which is now located in the right hammer

handle. The coil-vibrator-condenser assembly weighs only a few ounces and replaces a coil several times heavier and larger that formerly was a separate part connected to the hammer by heavy cable. The recommended electric source is a standard 6-v wet cell automotive type battery although a 6-v dry cell battery may be substituted. This hammer requires no auxiliary equipment or power source other than the ignition battery. It is completely portable and suitable for use at any location with a single operator. The hammer is air cooled and is powered with a single, two cycle, full floating piston. Fuel used is regular grade motor gasoline to which lubricating oil is added. Normal fuel consumption is one quart of gasoline per hour when operating continuously.

18—EXCITER PANEL HAS KNOB CONTROL

Latest development of the rotating amplifier-type generator voltage regulator announced by Allis-Chalmers Mfg. Co. is the voltage measuring and control panel that has no moving parts or electron tubes. This static regulating equipment is built in standardized panel sections, which can be mounted either in a convenient cubicle or in switchgear units. It consists of a compensating unit for reactive current division,

(Continued on page 18)

HERE'S PROOF!

Boiler rooms are
QUIETER, CLEANER, SAFER, with
SUPERIOR'S Built-in, INDUCED Draft.

Superior's Induced Draft prevents the escape of combustion gases into the boiler room . . . even through an open port. For our photo shows one of our engineers observing the fire through the wide open pressure-relief port.

It also explains one other distinct advantage of induced draft . . . the fact that the fire is pulled through each successive pass without impingement and wear on refractory as is the case under forced draft. For that relief port is at the end of the first pass where the combustion gases are turning the corner into the second pass. If they weren't being led, some of them would find their way out through the open port.

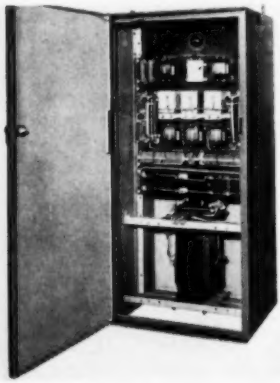
Greater quiet; longer trouble-free operation; cleaner, more healthful atmospheres are other primary results. We can't tell you the whole story here, but you'll find it all in our new catalog. Write today to reserve your copy of the newest edition. Ask for Catalog 302

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 18, N. Y.

SUPERIOR
STEAM GENERATORS

(Continued from page 16)

stabilizer panel, static voltage measuring circuit, a battery excitation switch and resistor and a damping transformer assembly mounted from top to bottom in the cubicle. A knob on the front of the reactive compensating units adjusts the auto transformer while reactors and other units are mounted



on the rear of the panel. The stabilizer panel consists of transformers giving rate of change signal, capacitors and resistors. It operates to compensate for the time delay inherent in machine fields due to field inductance.

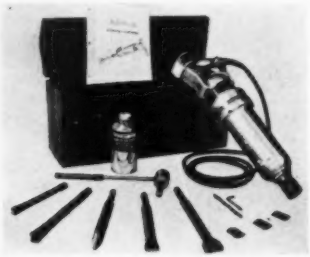
19—FILTER MEDIA COMES IN ROLLS

Glasfloss now has available a product, called the Glasfloss Roll-pak, that is made of long, fine glass fibres with low air resistance, high filtering efficiency, moisture-proof and fire-resistant for filter units. The frameless pack is made up in standard size rolls, 40 in. wide and 10 ft long, in both 1 and 2 in. thickness. Coarse wire screening, similar to chicken wire, can be used on both

sides of the filter. Once installed, there is no need for replacement of this screening. Only the used filter element is disposed. Changing filter elements is quickly and easily accomplished. The pack is simply rolled out, cut to size and installed between the screening. The time involved for filter replacement is reduced because the strips are cut to maximum lengths.

20—ELECTRIC HAMMER OPERATES ON LOW CURRENT

An electric hammer line, now being introduced in this country for the first time by Allied Tools, Inc., comes in three sizes —heavy, medium and light duty and includes a variety of special tools to suit many jobs. The hammer consists of a striker reciprocated by two centrifugal weights. The weights are attached to bevel gearing, which is driven through a spline shaft by a specially developed electric motor. It is fitted with a clutch that prevents overload when starting and shocks from reaching the armature spindle when sudden changes in velocity take place as the blow is struck. Current consumption is so low that the hammer can be



run off any ordinary 5 amp fitting. A voltage change block is incorporated in the 200/240-v hammers, and they can run on voltage from 200/210 or 220/240 by changing two connections. Other voltages available are 50, 100/110 and 240/260 v a-c single phase or d-c.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

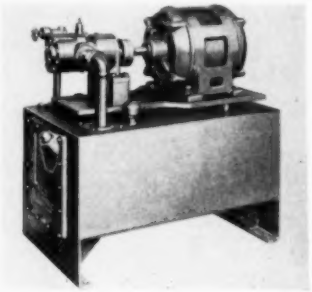
21—CONCRETE CUTTER SIMPLE TO OPERATE

Martin Fireproofing Corp. now has a gasoline motor equipped concrete cutting saw engineered to function indoors and out, regardless of job conditions or material being cut. Guide rails guarantee a smooth edged, straight cut and eliminate blade breakage generally caused by side to side wobble or the application of off center pressure. An intrigal part of the machine, these

guide rails not only improve performance and save blades but facilitate moving the unit. Over-all simplification of design has eliminated excess weight, lowered cost and made operation easier. The unit comes complete with a simple water hose attachment with diamond or specially bonded abrasive blades where dust suppression is required. Inexpensive abrasive blades are also available to dry cut concrete, asphalt or masonry.

22—HYDRAULIC POWER UNITS ARE COMPLETE

Vickers Inc. announces the addition of a line of hydraulic power units constructed in entire accordance with recommended J.I.C. hydraulic standards for industrial equipment. These features include: completely sealed tank, with breather air cleaner and



separate filler hole having removable mesh screen and chain-attached cap; elevated tank body with dished bottom, drain plug and cleanout holes at both ends to permit drainage without spillage and complete cleaning of the tank; and flush type oil level indicator with high and low oil positions marked. Motor mounting plate is separate from tank for convenience in mounting units. Available in three series, T20, T30 and T60, and 10 models for electric motors from ¾ to 25 hp. Single, double and two-pressure pumps can be used for 1000 psi service, and the two-stage pumps for 2000 psi service.

23—SAMPLES OF NON-MELTING LUBRICANT OFFERED

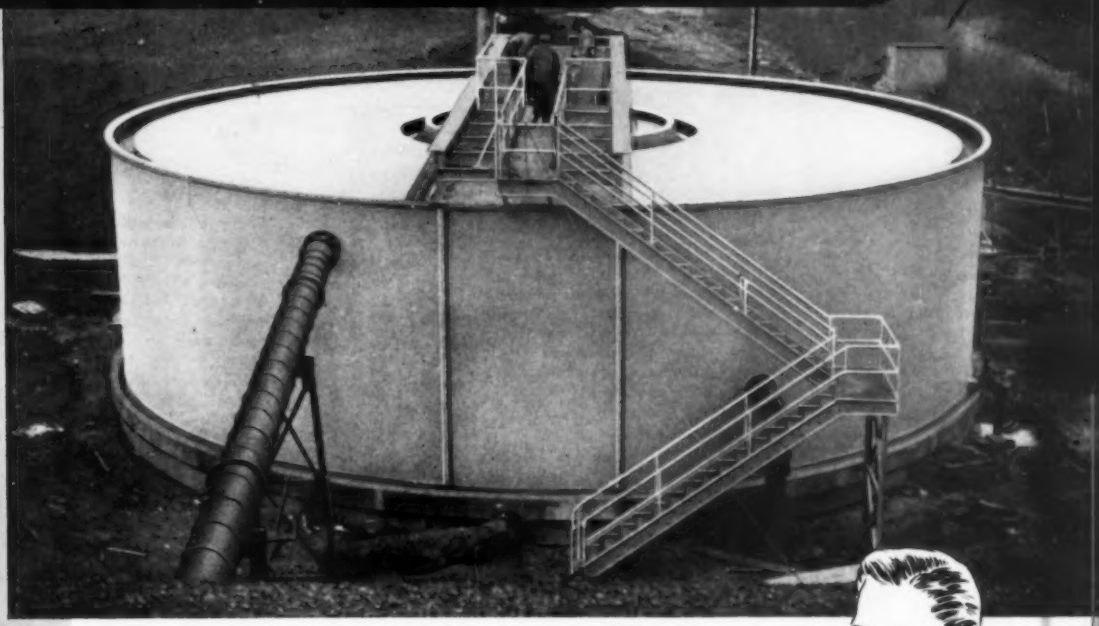
Specialty Products Co. announces a lubricating grease for use on either plain or anti-friction bearings in all locations in industry where both "cling" and lubricity should be maintained despite high operatinng temperatures. This material does not melt, even under the highest temperature conditions where lubrication is required. It is a synthetic grease, containing no metallic soaps, fatty acids, filler, water or alkali and is completely stable under all conditions of service and storage. Lubricity is held and perfect adhesion is maintained at the most elevated temperatures. This company will send a liberal sample for test purposes to any organization requesting it on their own letterhead.

24—TRANSMITTER HAS WIDE PRESSURE RANGE

Hagan Corp. announces a high pressure flow signal transmitter, a pneumatically operated flow differential measuring unit that transmits proportional signals to remote recording or indicating instruments, or to automatic control units. It is used for measuring flow differentials of liquids, gases or vapors, and measuring static pressure or liquid level. Interchangeable measuring elements cover a continuous range of pressure differential from 5.5 in. water column to 100 psi, at static pressures up to 1500 psig. The transmitter consists essentially of an input differential pressure measuring unit,

(Continued on page 22)

A *Good* waste-treatment system...



costs *far less* than you think!

HERE'S HOW ONE MAN LEARNED THIS FACT:

A paper manufacturer, faced with the problem of waste treatment in his plant, guessed that a good system would cost him a six-figure sum. To avoid paying so high a price, he sunk a considerable amount into a home-made system—which simply did not do the job. And so he called in consulting engineers.

After making a complete survey of the mill, analyzing samples of its waste, and thoroughly studying the problem, the engineers made their recommendations. They were accepted by the surprised manufacturer, and the system was built.

The waste-treatment plant cost *even less* than the supposedly-cheap makeshift equipment that had failed, and it provided an effluent completely acceptable for re-use in the mill.

It also produced some benefits the manufacturer never expected:

- **A large amount of raw stock was recovered**
- **Stream pollution was eliminated**
- **There was an important reduction in heat losses**

The manufacturer estimates the new system will have paid for itself within three years!

Maybe *you* have been putting off the question of water, sewage, or industrial waste treatment for your plant or community because you think the cost prohibitive. Don't guess; you will probably be wrong! *Call in consultants specializing in this field.*

FREE BOOKLET

FOUR WAYS TO ECONOMIZE ON INDUSTRIAL WASTES ... is a factual treatise offering much useful information on its subject. Write for your copy today! Address: Gilbert Associates, Inc., 412 Washington St., Reading, Pa.

GAI FOUNDED 1906

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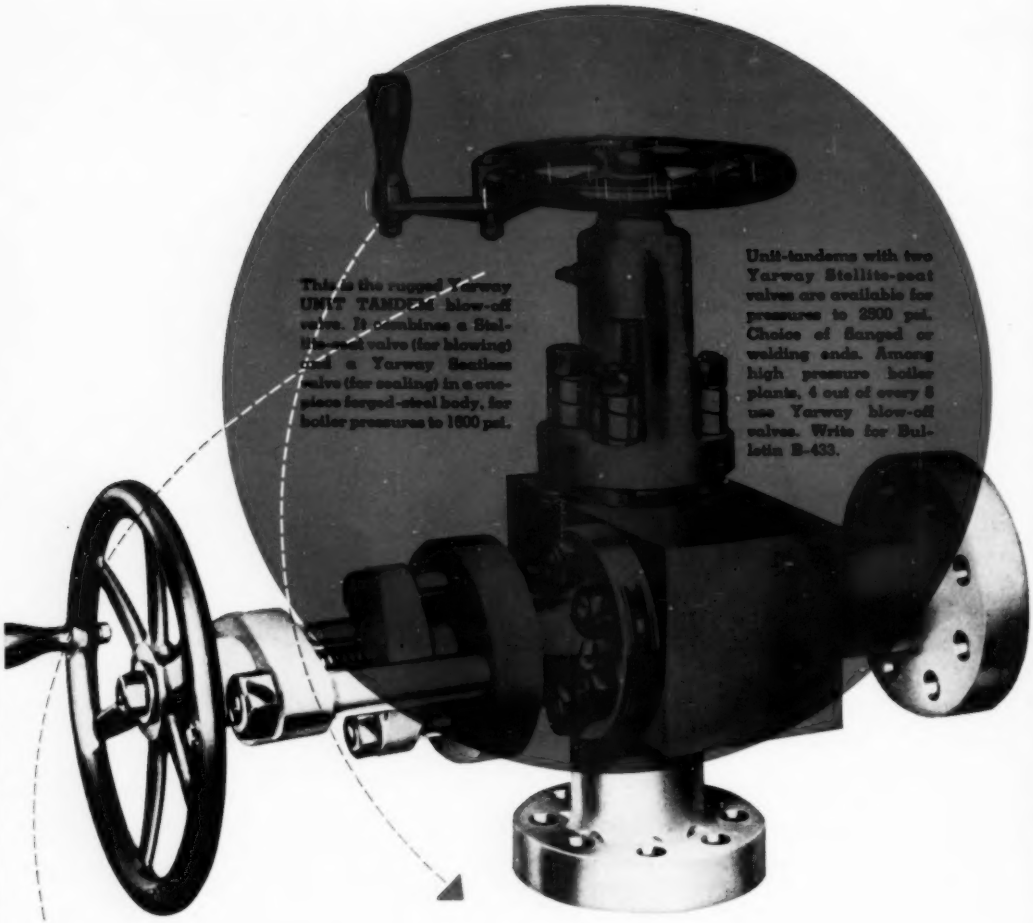
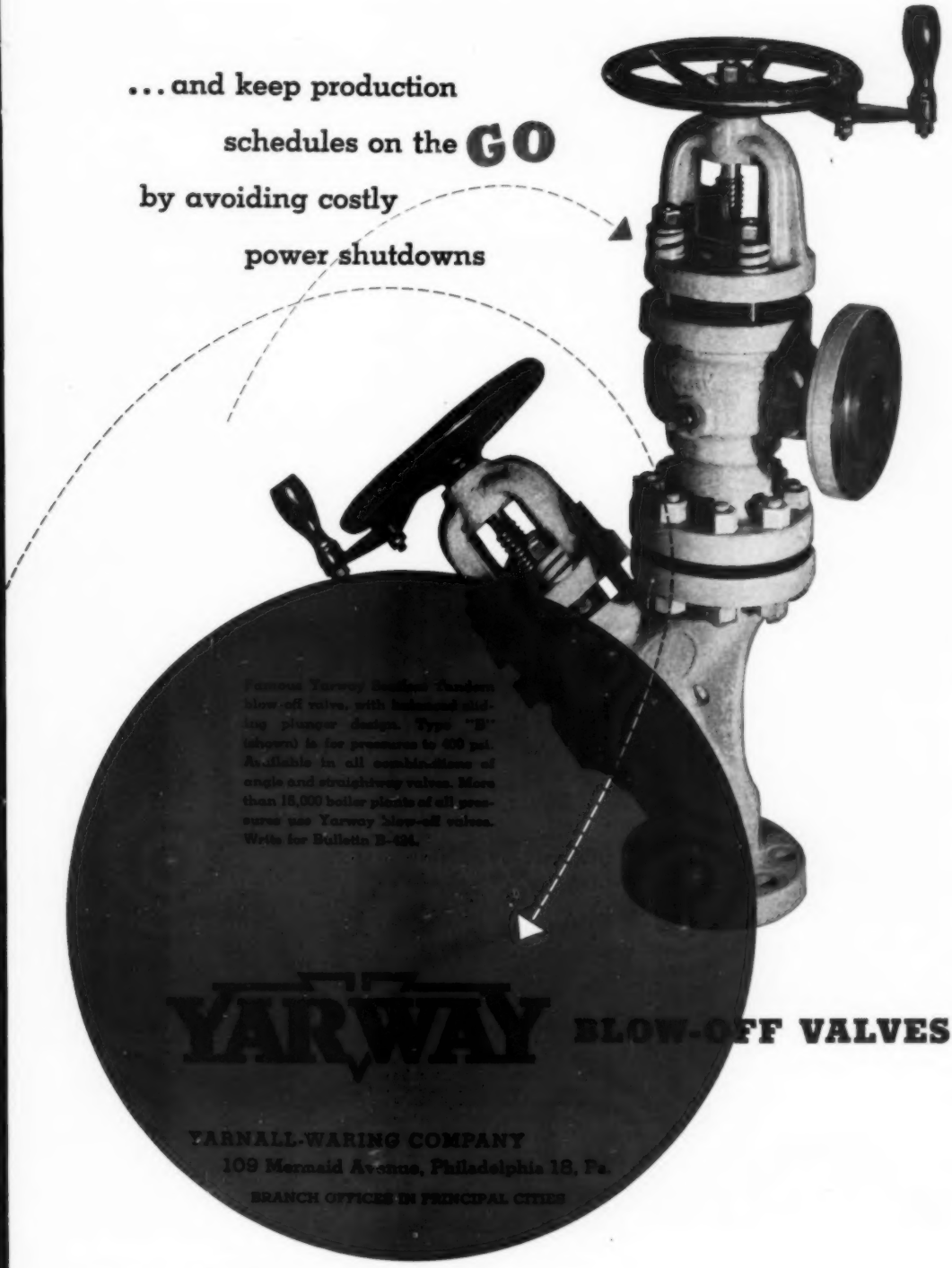

This is the rugged Yarway UNIT TANDEM blow-off valve. It combines a Stellite-seat valve (for blowing) and a Yarway flextlex valve (for sealing) in a one-piece forged-steel body, for boiler pressures to 1600 psi.
Unit-tandems with two Yarway Stellite-seat valves are available for pressures to 2500 psi. Choice of flanged or welding ends. Among high pressure boiler plants, 4 out of every 5 use Yarway blow-off valves. Write for Bulletin B-433.

Dependable Yarway Blow-Off Valves

STOP a lot of

boiler blow-down troubles . . .

...and keep production schedules on the GO by avoiding costly power shutdowns



Famous Yarway Resilient Tandem blow-off valve, with balanced sliding plunger design. Type "B" (shown) is for pressures to 400 psi. Available in all combinations of angle and straightway valves. More than 15,000 boiler plants of all pressures use Yarway blow-off valves. Write for Bulletin B-424.

YARWAY BLOW-OFF VALVES

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

What Other Drive Gives You...

1. SIMPLICITY, LONG LIFE

So simple that it can be serviced by relatively unskilled mechanics...so rugged that it stands abuse that would wreck other drives...so dependable that it is consistently used where unfailing service is imperative—these are typical advantages gained from the Troy steam engine's basic simplicity. Long life, also, stems from this inherent simplicity and ease of maintenance. Year after year, under the most adverse conditions, Troy Steam Engines continue to deliver dependable, low-cost power.

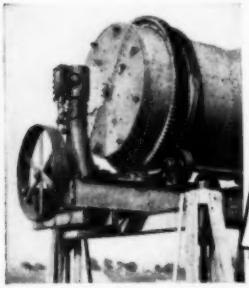
Plus-

2 ACCURATE, FAST SPEED CONTROL

3 BY-PRODUCT POWER

4 HIGH STARTING TORQUE

5 UTMOST FLEXIBILITY



Year after year: Up in the air, out in the open, the Troy Steam Engine continues to drive this kiln in an asphalt paving plant after many years of dependable operation.

Which Do *You* Need?

If your drive needs any or all of these five characteristics, the modern Troy Steam Engine is indicated. Send us your drive requirements and steam conditions, and our engineers will be glad to recommend the right type and size Troy engine to meet your needs.

Send for Bulletin 306

TROY

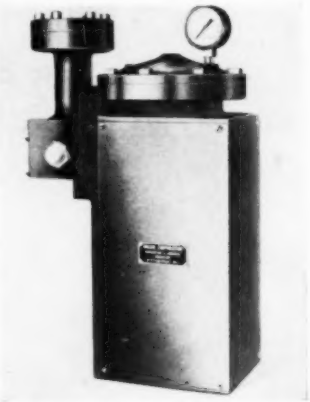
Troy Engine & Machine Co.

Power Equipment Division

1202 RAILROAD AVENUE • TROY, PENNSYLVANIA

(Continued from page 18)

force balanced by an output system. Pressure differential across an orifice, flow nozzle or other primary device is connected to the measuring element, which is enclosed in a pressure chamber and is designed for the maximum service required of the unit.

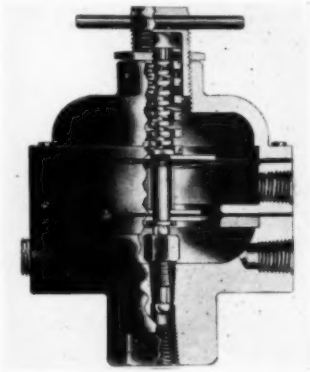


Torque produced by the pressure differential is balanced by the force produced by the modulated air pressure that is transmitted from the pilot valve to the balancing diaphragm. The force is transmitted by the diaphragm through a linkage system.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

25—REVERSING RELAY DELIVERS FULL OUTPUT

Black, Sivalls & Bryson, Inc., has announced a reverse action relay that is designed with bronze case, top and non wearing parts. Ratio plates, inner valve and



seats are of stainless steel with diaphragms of nylon inserted neoprene. The relay is conducted specifically for the purpose of de-

(Continued on page 24)

Peter Cooper* Corporations served by DETROIT STOKERS

19 DETROIT STOKERS IN FOUR PLANTS SINCE 1939

● DETROIT STOKERS
In Plants of Peter Cooper Corporations

Eastern Tanners Glue Division
Gowanda, N. Y.
1939—Five Detroit RotoStokers
1943—Two Detroit RotoStokers

Canada Glue Company, Ltd.
Brantford, Ontario
1939—Three Detroit RotoStokers
1946—One Detroit RotoStoker

Diamond Glue Division
Chicago, Illinois
1944—Two Detroit RotoStokers
1945—Two Detroit RotoStokers

United States Glue Division
Carrollville, Wisconsin
1946—Two Detroit RotoGrate Stokers
1947—Two Detroit RotoGrate Stokers

Peter Cooper Corporations—one of the oldest firms in America—has bought Detroit Stokers in quantity since 1939.

Detroit Stokers have been highly satisfactory in meeting the demands for large outputs of process steam with fluctuating loads. Their economy, ability to handle a wide range of bituminous coal without special preparation resulted in these repeat orders.

Detroit Stokers can provide economy in your plant. Write for information.

● Detroit RotoGrate Stokers at United States Glue Division, Carrollville, Wisconsin.

Above: Five of seven RotoStokers in Eastern Tanners Glue Division, Gowanda, New York.

● Below: Two of four RotoStokers at the Canada Glue Company, Ltd., plant, Brantford, Ontario.

*Peter Cooper (1791-1883) was one of the great pioneers of American Industry. Entering the glue and isinglass business early in the 19th Century, he ranged into many fields of endeavor. He built "Tom Thumb", the first locomotive built in America—was early in the iron and steel business—made the first rolled structural beams—was the first in U. S. to use the Bessemer steel making process. He also furnished much of the cash for laying the first Atlantic cable. Cooper is most famous for the Cooper Union, New York City, which he founded in 1859. Here, in 1860, Abraham Lincoln made the famous speech which opened his way to the presidency

DETROIT SINCE 1898 STOKERS

THERE IS A TYPE AND SIZE OF DETROIT STOKER FOR EVERY INDUSTRIAL OR POWER NEED

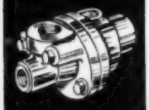
DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities . . . Works at Monroe, Michigan

Standard Swivel Joints
For pressures from 125 psi to 15,000 psi.

High Temperature Swivel Joints
For temperatures to 600° F. W.W.P. 300 psi.


Rotating Joints
For 150-lb. steam, brine, etc.

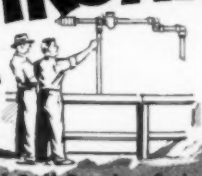
Sanitary Swivel Joints
For Food Processing, Dairies, etc.

Hydraulic Swivel Joints
For pressures to 3,000 psi.

DESIGN

There is No Substitute for ~~Experience~~ CHIKSAN

MANUFACTURE


APPLICATION

Only with CHIKSAN ***Ball-Bearing*** Swivel Joints* can you benefit from a quarter-century of ***specialized experience*** in the development, design, manufacture and application of Swivel Joints for all purposes. CHIKSAN'S resources, facilities and personnel are ***concentrated exclusively*** on the production of Swivel Joints and their application to all kinds of installations. This is your assurance of efficient performance, long life and low-cost maintenance. There is no substitute for CHIKSAN!

CHIKSAN Engineers will gladly cooperate with you in selecting the correct Types and Styles of Swivel Joints for your particular requirements...and in specifying the proper Packing Unit for the fluid you handle. This valuable, experienced counsel costs you nothing.

*For full 360° rotation in 1, 2 and 3 planes. Unlimited flexibility in pipe lines can be secured simply by arranging swivels in proper sequence.

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AND SUBSIDIARY COMPANIES
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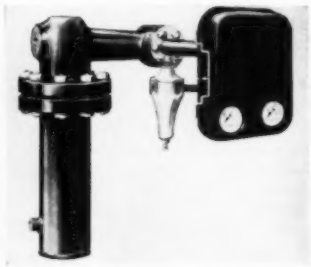
BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

livering maximum pressure output at the minimum pressure input from pilot or other controlling source, or vice versa, without any modification whatever in either pilot or valve hookup. If reversal of valve closure in relation to pilot action is required from time to time, installation of this relay in a by-pass line will provide a simple, fast and inexpensive way to make the change.

26—LIQUID CONTROLLER HAS TORSION TUBE

A displacement liquid level controller has been designed by Black, Sivalls & Bryson, Inc., for external mounting on receivers, separators and other similar services where it is desired that the liquid level controller be isolated without shutting down the main

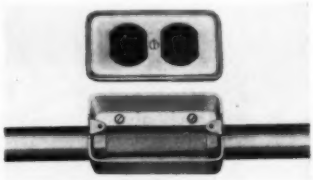


systems when repair or adjustments are necessary. The device utilizes a torsion tube assembly for transmitting level changes, thus eliminating objectionable packing glands and pressure type bearings. These units are recommended for all types of liquid level control applications involving exacting and wide range control.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

27—RACEWAY FITTING HAS POSITIVE GROUND

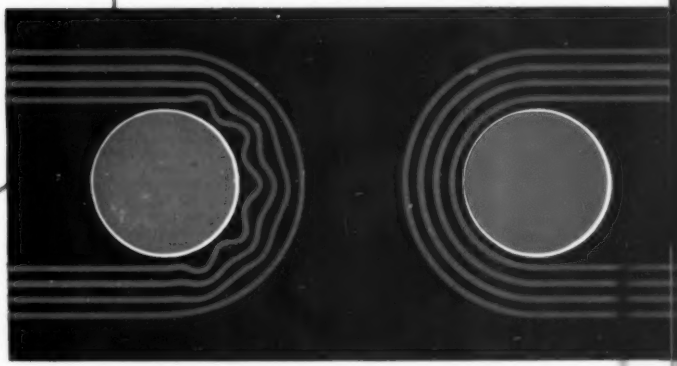
A service fitting for its Florduct raceway line has just been announced by National Electric Products Corp. The body of the device fitting is made of 14-gage steel and is



designed to preserve a continuous raceway base. Constructed to eliminate hazards caused from abuse and water seepage and electro-galvanized to make it rust-resistant. The housing is installed over the raceway base without cutting the raceway. After installation and "lay-in" of conductors, the

(Continued on page 132)

POWER FROM EVERY PLY



Condor COMPENSATED BELT

Users tell us Compensated Belts outlast ordinary transmission belts—as much as 3 to 4 times on some drives. • • • There are sound engineering reasons for this. With our patented Compensation construction, as diagramed on the *right* in panel above, you get more power, more belt-life, because each ply pulls an equal share of load around the pulley. • • • Longer life and trouble-free service are assured, as Compensation prevents outer ply ruptures, fastener troubles, ply separation, which often occur in regular belts as diagramed at *left* above. Wire for Bulletin 6808-J, which explains these and other features. • • • Extra long life is also engineered into R/M hose, V-belts and conveyor belts. See your R/M distributor.

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new bulletins and catalogs

Be sure to order your free copy of these booklets—they're the latest information published by leading manufacturers. Use the postage-free order cards on page 117. Just list the key numbers of the bulletins you want in the spaces provided on cards

BOILERS, AUXILIARIES, ACCESSORIES

200—Steam Generators. Illustrated catalog offers choice of four types, in fifteen sizes, from 5 to 250 hp, for firing with gas, light or heavy oil, stoker-coal or by hand. Cutaway view shows arrangement of heating surfaces. Full discussion on construction and design features is included. In addition, the booklet mentions other products along with facilities for handling custom work to contract specifications. Hapman-Dutton Co.

201—Over-Fire Air Systems. "Burn the smoke" for cleaner more efficient coal heating, says Canton Stoker and then shows how it's done in 8-page bulletin on Turbo-Aire over-fire air systems. Contains thorough discussion on principles of combustion and smoke elimination. Gives full description of the equipment along with cutaway and diagrammatic views showing units in action. Selection chart, specifications, and fan data and characteristics are included as is brief description of automatic controls. Three types of stokers are illustrated and short descriptions given. Canton Stoker Corp.

202—Block Insulation. Economic advantages and properties of Superex block insulation are listed in 4-page folder 1N134A. Conductivity and heat loss graphs are given as is recommended thickness table. Drawings show some of the special shapes available. Johns-Manville.

203—Furnace Enclosures. Suspended arches and sectionally supported walls, and their application to all types of furnace enclosures are presented in 32-page bulletin No. 4. Efficient operation; ease of installation; low maintenance; these are some of the advantages outlined in the 2-color catalog. Drawings, cutaways and photographs portray the Duo-Seal construction. Of particular interest are series of charts showing heat losses from walls of varying thicknesses. Laclede Arch Co.

204—Stokers. Continuous ash discharge stokers are the subject of 4-page bulletin. Cutaway views show how the grates may be installed to discharge to either front or rear. Gives list of boilers equipped with the units and offers engineering service for consultations. Another 4-page folder tells the story of spreader stokers. Photos and drawings present features that make it possible to operate at high ratings and high furnace temperatures. Hoffman Combustion Engineering Co.

205—Refractory Products. Well-illustrated 52-page bulletin gives installation procedures and anchoring methods for refractory material that has the consistency of stiff putty. Explains why fire brick linings fail and offers suggestions on how to overcome the failures with monolithic construction. Numerous diagrams, drawings and photographs graphically portray the simplicity of working with any of the four products described. Settings for all types of boilers are shown and numerous accessories for efficient boiler operation are illustrated. Plibrico Jointless Firebrick Co.

206—Precipitators. Bulletin 1728 contains factual information on precipitators designed to handle fly ash, cinders, and industrial dusts. The 12-page booklet gives operational data and shows the compact arrangement of the units. Performance factors, efficiency curves and selection charts are included as is dimensions and physical data table. Shipped in sub-assemblies and also available in combination packages. American Blower Corp.

207—Condenser Tubes. Present restrictions on the use of copper and its alloys still further stress the importance of extending condenser tube life. "Life Extension for Condenser Tubes," is a 28-page report on causes of corrosion and means of combating them, as well as on the choice of condenser tube materials. Divided into nine sections, the book tells the complete story from preventive metallurgy to composition and general recommendations. Useful table gives estimating data for condenser and heat exchanger tubes in various alloys. Revere Copper and Brass Inc.

208—Tube-Supported Walls. How walls may be suspended directly from boiler tubes with resulting savings in steel and erection times is detailedly described in 12-page catalog. Engineering drawings show typical jobs and portray how the enclosure is fastened to the boiler tubes. Of particular interest is a series of photos showing a job being erected. Bigelow-Liptak Corp.

PRIME MOVERS: DIESELS, TURBINES, COMPRESSORS

209—Multi-Stage Turbines. Smaller framed, multi-stage turbines are featured in 6-page bulletin. Overspeed governor, governor valves, blades, diaphragms and many other design features are discussed and illustrated. The Terry Steam Turbine Co.

210—Vertical Drive Steam Turbine. Concise 4-page booklet VT351 describes and gives technical data for vertical drive steam turbine. Built in three general sizes and handles industrial applications up to 600 hp with thrust loads of 8000 lb or more and steam conditions as high as 900 psig and 900 FTT. Includes other facts pertaining to such applications as geared circulating and boiler feed pumps. The Whiton Machine Co.

211—Refrigeration Compressor. Detailed description of the 2, 3, 5, and 7½ hp hermetically sealed refrigeration compressors and condensing units is given in bulletin 101-110. Features of the units are discussed in detail and illustrated liberally. Complete specification data are included. Westinghouse Electric Corp. Sturtevant Div.

212—Turbo Compressors. Comprehensive information on the application of turbo compressors to oil and gas fired equipment used in agitation, cooling, drying, gas boosters and pneumatic systems is provided in 12-page bulletin 126-A. Performance curves, tables of capacities for both vacuum and pressure applications are included. The Spencer Turbine Co.

213—Plant Equipment. Booklet 122-A describes compressors, vacuum pumps, ejectors, centrifugal pumps, blowers, engines, condensers and other plant equipment. Well illustrated with installation photos, the 12-page publication also shows cutaway drawings of many units. Refers to catalogs for more detailed information on specific products. Ingersoll-Rand Co.

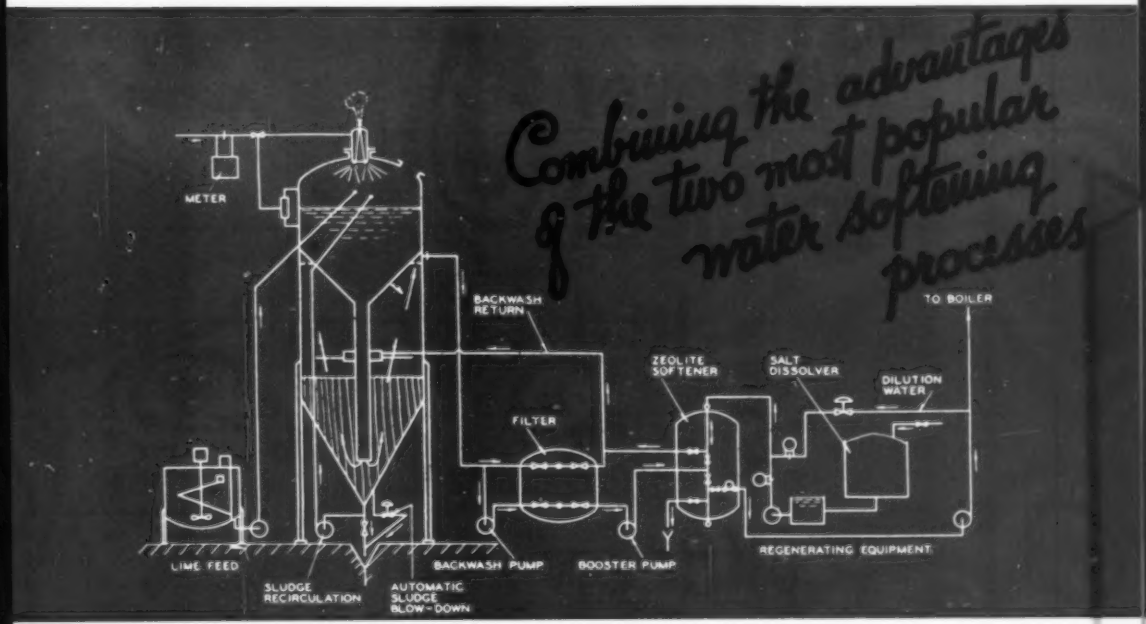
WATER AND LIQUID TREATMENT

214—Heat Exchanger. If you must use dirty cooling water better look into the advantages of film type heat exchanger described in bulletin HE-7. Can be cleaned while in operation, according to the 8-page booklet which tells the whole story including design and construction features. Gives applications in several industries and shows installation photographs of various units. Henry Vogt Machine Co.

215—Fluid Coolers. Jacket water coolers for gas, gasoline, diesel engine and fluid cooling, said to be capable of withstanding the abuse of portable equipment installations, are illustrated and described in 4-page bulletin 1351. Many new design features are set forth

(Continued on page 30)

cochrane hot process zeolite water conditioner



1. saves chemicals
The zeolite softener uses salt instead of the more expensive soda ash and phosphates, bringing down the cost of chemicals considerably.

2. saves on capital investment The cost of adding zeolite equipment to a hot process installation is far less than the addition of an independent sedimentation tank and chemical feed for a two-stage phosphate process.

3. lower CO_2 in steam
The lower alkalinity resulting from using lime alone, plus the fact that this alkalinity is all carbonate, causes a reduction in CO_2 generated in the steam.

4. less operating attention The use of the zeolite softener with its simplicity of operation is an advantage which is enhanced by the longer periods between regenerations, due to the lower hardness of the hot process softener effluent.

5. less floor space and head room required
The addition of the zeolite equipment requires less floor space and less head room than that required for two stage phosphate equipment.

6. lower alkalinity The use of lime (or Dolomitic lime) as the sole reagent in the hot process means that the alkalinity can be reduced to about half that obtained with lime and soda ash.

7. only one chemical needed in the hot process It is generally possible to use a single reagent in the hot process, namely lime or Dolomitic lime, precipitating the bicarbonates and magnesium, leaving the remaining hardness to be removed by the more economical zeolite.

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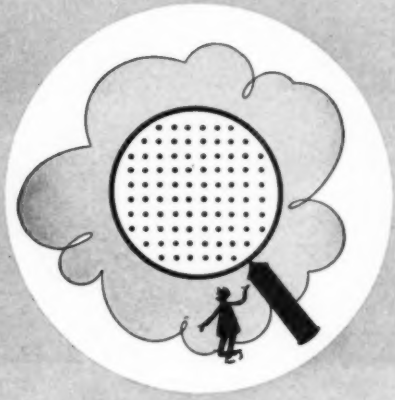
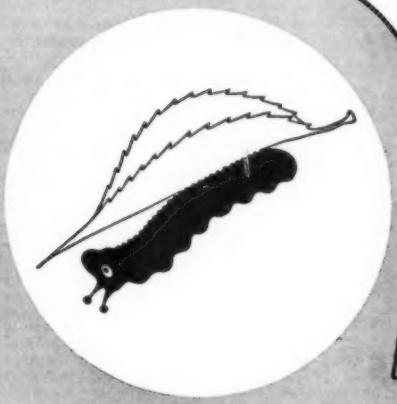


DISTRIBUTION throughout the steam

HIGH TEMPERATURE resistance



ADHESION to cylinder walls and valves

RESISTANCE to washing off lubricated surfaces

Complete SEPARATION from condensate

Sinclair has it!

No matter what your operating conditions—
pressure, temperature, quality of steam; speed, loading;
condensing or non-condensing—
there is a Sinclair Steam Cylinder Oil made expressly
to give the utmost in lubrication satisfaction.

Through proper combinations of steam cylinder stocks and compounding ingredients, Sinclair lubrication technologists have developed a series of steam cylinder oils to fit the operating needs of any installation. There are oils that provide quick atomization . . . persistent adhesion to cylinder walls in the presence of moisture . . . rugged, wear-resisting lubricating films under super-heat . . . or complete separation from condensate where that is the dominating requirement.

A Sinclair lubrication engineer will help you select the proper oil for your particular service.

SINCLAIR
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For lubrication counsel see your nearest Supplier of Sinclair Products or write Sinclair Refining Company, 630 Fifth Avenue, New York 20, N. Y.

Single or double fan installations with automatic controls. Double operates on single furnace, or serves two. On single furnace either fan can operate up to 70 percent capacity, other fan then cuts in automatically.

TYPE 1 TYPE 1A

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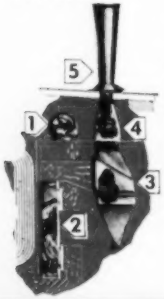
You eliminate fluctuations or losses in draft efficiency by the use of Prat-Daniel Stacks. P-D Fan Stacks coordinate the relationship of fans, breeching and stacks to provide and maintain maximum efficiency.

Thousands of P-D Fan Stacks in long operation have proved their superior reliability over induced-draft fans and stacks purchased separately. Easily applied to any installation, they provide highly efficient draft for the load conditions of your power plant.

Our project engineers provide expert assistance on any problems of draft production and control. Call them on current problems or planned installations. Write for Catalog No. 200.



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Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream shown at left; 1. Forced Draft Fans, 2. Air Pre-heaters, 3. Tubular Dust Collectors, 4. Induced Draft Fans and 5. Fan Stacks. This unit responsibility, by a well-known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

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Designers and Manufacturers

PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.

(Continued from page 26)

in detail along with descriptions of optional accessories. Young Radiator Co.

216—Cathodic Corrosion Control. Full discussion on the cathodic system of corrosion control is contained in 6-page bulletin. Gives causes of corrosion, its effect, and offers solution. Completely integrated service for survey, design, installation, material and servicing is outlined. The Harco Corp.

217—Organics. Interesting 4-page folder describes the need for organics in altering the nature of sludge in order to make it non-adherent. It covers the theoretical and practical considerations involved in the use of organics, and describes and illustrates the manner in which they overcome the problems of sludge. Also contains microphotographs of adherent sludge, showing the results that can be expected from the use of organics. E. F. Drew & Co., Inc.

FILTERS, STRAINERS, CLARIFIERS, DEHYDRATORS

218—Lime Hydrators. Continuous lime hydrators are described in 8-page bulletin 49. Covers the theory of lime hydration, as well as construction details, dimensions and capacities. Briefly discusses vertical and horizontal-rotary lime kilns, tube mills for hydrate grinding, conical mills for limestone reduction, continuous rotary dryers and regulating feeders. Hardinge Co., Inc.

219—Oil Purification. Up-to-date information on oil purification for hydraulic equipment, metal-working machines, gas and diesel engines, turbines, transformers, etc., is given in 16-page booklet, entitled "The Facts About Clean Oil". Answers questions about oil purification and shows correct method and equipment to improve and increase efficiency. Actual case histories quote substantial savings in oil consumption and equipment operating and maintenance costs. Photographs illustrate applications of the equipment. Honan-Crane Corp.

ELECTRICAL EQUIPMENT

220—Instrument Transformers. Illustrated 93-page brochure, GEA-4626, supplies pertinent buying information on instrument transformers. Divided into sections which offer technical data on indoor and outdoor potential transformers, current transformers, metering outfits, potential and current portable transformers. Listings of ratio and phase-angle tests, coupled with tables covering the mechanical and thermal limits of current transformers, round out the balance of the publication. General Electric Company.

221—Large Induction Motors. Large, polyphase induction motor, and where it fits into the industrial picture, is the subject of 28-page booklet, B-4739. Presents illustrated summary of types and features of two basic kinds of induction motors—squirrel-cage and wound-rotor motors. Applications are illustrated for a number of industries. Westinghouse Electric Corp.

222—Single-Feeder Substations. Application of the CSP power transformer as completely packaged, single-feeder substation is described in 16-page bulletin B-4692. Combining the 43 components of conventional substation into single unit saves both time and money in planning, installing, maintaining, and moving the equipment, it is claimed. Illustrated description is included on tap changer equipment, automatic overload and short-circuit protection, instrumentation and instrument transformers, and low-voltage switching. Westinghouse Electric Corp.

223—Synchronous Generators. "Hydraulic Turbine Driven Synchronous Generators and Large Vertical Motors" compares the suspended and umbrella types of vertical generators, describing construction details. In addition, the horizontal generator is described. Special modifications that can be incorporated into the design of hydraulic turbine generators are listed, along with accessories and tools. Large vertical motors are briefly described and mention also is made of the combined motor-generator unit that can be used alternately as a hydraulic turbine-generator and as a motor-driven pump. Bulletin O5B7549, 32 pages. Allis-Chalmers Mfg. Co.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

224—Enclosed Motors. Especially suitable where corrosion is a problem are these totally enclosed fan-cooled motors says 4-page bulletin MU-132. Explains the advantages of cast iron construction and describes other features which are said to add up to a long life and dependability. Available in ratings from 2 to 250 hp. Frame sizes and principal dimensions are given. Lists recommended applications. Wagner Electric Corp.

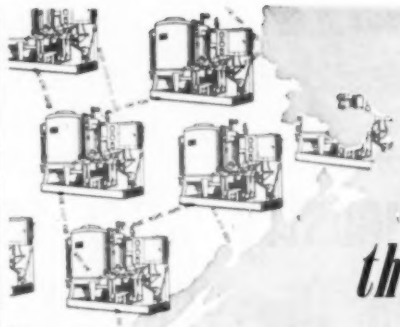
225—Panelboards. Standard unit steel panels, designed in several sizes, with accessories for quick, easy installation are described in 4-page catalog 143. Shows the arrangements possible with various units. Numerous features are described. Falstrom Co.

INSTRUMENTS, CONTROLS, RECORDERS

226—Power Factor Meter. Economic benefits of high power factor may be easily obtained through application of direct reading, hook-on power-factor meter, according to bulletin GEA-5469. The 16-page booklet gives full description of the instrument together with on-the-job photos. Such other testing instruments as hook-on volt-ammeter, hook-on wattmeter, portable recorders, phase-sequence indicator, etc., also are covered. General Electric Co.

227—Flow Instruments. Years of experience—41 of them—enable Penn to offer a diversified line of instruments. The following bulletins are 4-page pub-

(Continued on page 34)



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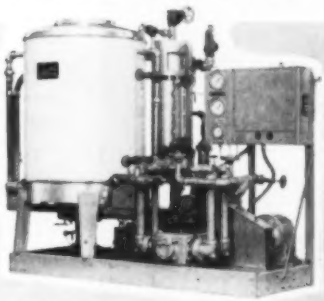
THERE ARE MORE *Clayton* FORCED RECIRCULATION STEAM GENERATORS IN USE THAN *ALL OTHER PACKAGE TYPE BOILERS COMBINED

*Self contained steam generators of from 15 to 100 horsepower



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An animated, colored flow chart shows you how and why the Clayton Forced Recirculation principle can cut your steam costs.

IP-6

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Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.

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...Industry after Industry has selected the VERTICAL-UNIT BOILER

PARTIAL LIST OF INDUSTRIES THAT HAVE SELECTED THE VU-10 BOILER

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COLD STORAGE
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FOOD
GLASS
HOSIERY
HOSPITALS
INSTITUTIONS
LAUNDRIES
LEATHER
LINOLEUM
MACHINERY
METALS
OIL
PACKING
PAINT
PAPER
RAILROADS
RUBBER
SCHOOLS
STEEL
SUGAR
TEXTILE
TOBACCO
UTILITY

A glass plant in Ohio . . . a chemical plant in West Virginia . . . a floor covering plant in Delaware . . . plant after plant, representative of virtually every branch of industry, has chosen the C-E Vertical-Unit Boiler, Type VU-10 to meet its particular steam requirements. Here are six important reasons for the VU-10's industry wide acceptance:

Balanced Design – Not one or two features for special needs, but a *completely balanced design* that adapts itself to many conditions. A design in which each element is coordinated with every other for top performance.

Efficient Performance – The VU-10 has high efficiency over a wide range of output, produces steam of satisfactory quality at all ratings and responds to rapid load swings . . . all characteristics of advantage to many industrial plants.

Easy Operation and Maintenance – The VU-10 is simple to operate and maintain – especially advantageous for plants with limited operating and maintenance forces. All parts readily accessible for such cleaning and maintenance work as may be necessary.

Choice of Fuels and Firing – In addition to its wide adaptability, the VU-10 permits you to choose the one *best* method of firing for the fuel and load conditions of *your* plant.

Lower Cost – The standardized balanced design of the Vertical-Unit Boiler effects economies in engineering, fabrication and erection which are passed on to you in lower first cost.

Unified Responsibility – The Vertical-Unit Boiler is a complete unit . . . boiler, furnace setting, fuel-burning equipment, controls, forced draft . . . bringing you the added benefit of one contract, one guarantee and one responsibility.

• • •

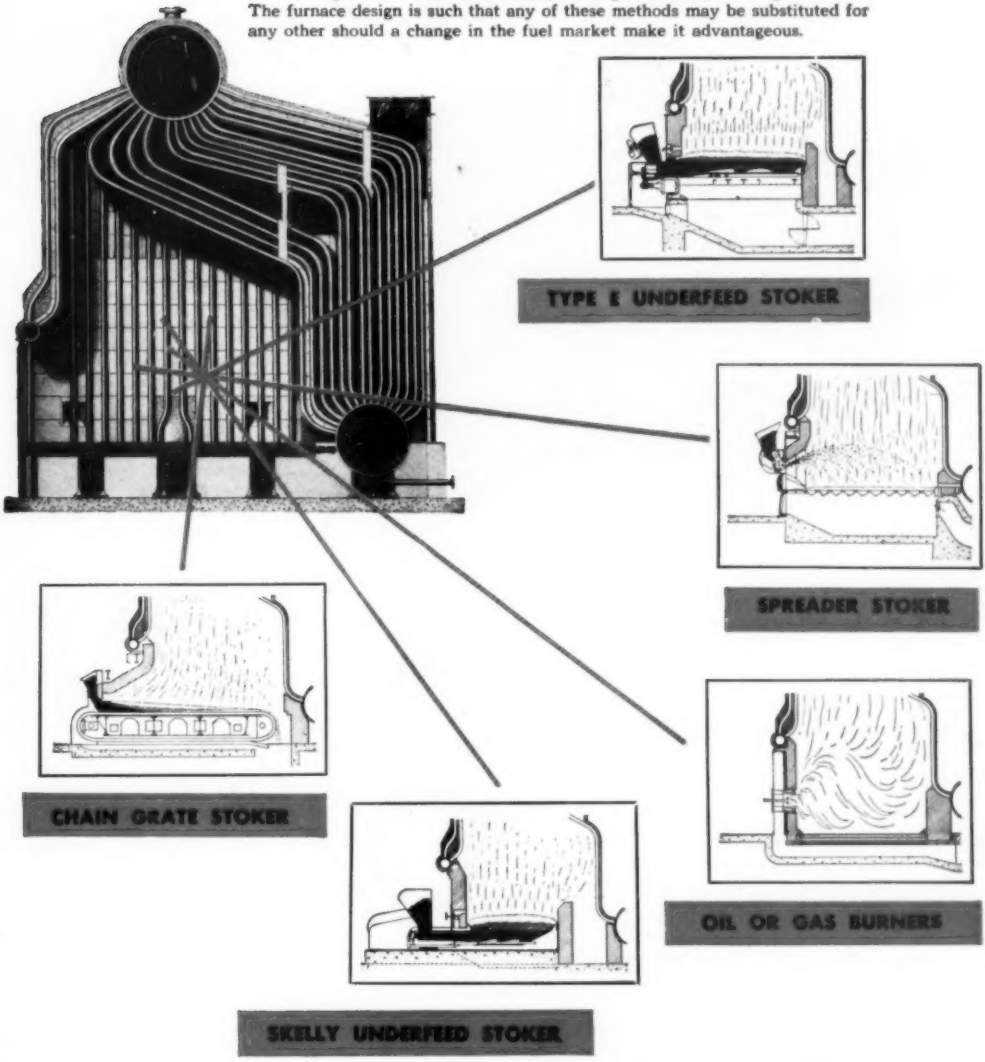
The design, construction and operating features of the VU-10 meet all the requirements of a modern industrial plant. Small wonder so many diverse industries select this unit for their steam needs. If your requirements fall within the capacity range, 10,000 to 60,000 lb of steam per hour, it will pay you to investigate the VU-10. Our engineers will welcome the opportunity to discuss the matter with you or your consultants at your convenience. 8-381

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

For every fuel market and every type of load there is *one best* method of firing. The selection of that *one best* method for the fuel and load conditions of a particular plant calls for judgment based on broad experience and free from any incentive to favor one type of equipment over another.

The Type VU-10 Boiler is designed for five methods of firing – spreader stoker, single-retort underfeed stoker, chain grate stoker, oil or gas burners. The furnace design is such that any of these methods may be substituted for any other should a change in the fuel market make it advantageous.



— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Get TWICE the value for your steam trap dollar!

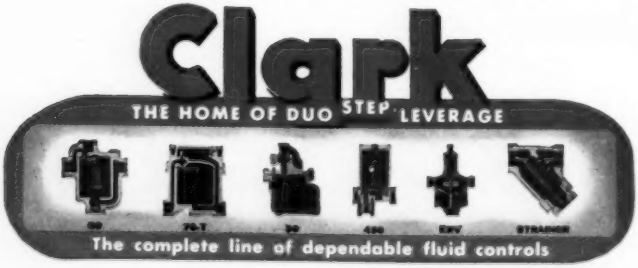
Just as the self-starter revolutionized the automobile, so Clark Duo-Step Leverage is changing old-fashioned ideas about steam trap efficiency.

Field and laboratory tests prove that Clark DUO-STEP Steam Traps more than *double* the drainage capacity of ordinary inverted bucket traps.

Ask your Clark representative for a demonstration on your steam lines—or write us for complete information.

Here's how DUO-STEP doubles drainage capacity

THE CLARK MANUFACTURING COMPANY
1845 East 38th St. • Cleveland 14, Ohio



lications and are well illustrated with photographs, diagrams and cutaway views. Catalog 650 covers linameters, a variable area type of flow meter, recommended especially for fluids not suitable for orifice meters. Available in electric, electronic, mechanical and pneumatic models.

228—Pump by-pass control, for protection of high pressure centrifugal pumps against overheating at low flows, is the subject of catalog 925.

229—Magna-clutch flow controllers (differential pressure or variable area types) assure metering accuracy and operating convenience according to catalog 950.

230—Catalog 975 tells the story of automatic compensators for temperature and/or pressure. Full discussion of principles accompanied by formulas and diagrams is included. Penn Industrial Instrument Corp.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

231—Electronic Equipment. Limited to industrial purchasing agents, this lavishly illustrated, 1053-page catalog lists products of the major manufacturers, complete with prices and discounts, and will serve as a valuable ready-reference buying guide. Lists industrial electronic parts and equipment for practically every industrial application. Write on company letterhead to Milo Radio & Electronic Corp., Dept. IP, 200 Greenwich St., New York 7, N. Y.

232—Heating Controls. Latest information on heating controls is contained in 60-page illustrated catalog. Simplified specifications, control system selection chart, thermostat heater data are included. Related controls are grouped together for quick reference. Cross index helps find specific items. Minneapolis-Honeywell Regulator Co.

233—Synchronous Motor Controls. Polarized field frequency controls (standard interrupting capacity type) for synchronous motors are covered in 8-page bulletin 3100-PRD-204. Illustrates and describes in detail all the standard types for full-voltage, reduced-voltage, and part-winding starting. Also replete with helpful data including ratings, weights, dimension drawings, wiring diagrams, layout drawings, and specifications for each type of control that is covered. The Electric Machinery Mfg. Co.

234—Air-Operated Combustion Control. Fundamental principles of automatic combustion control and their application to boilers fired with fuels burned in suspension or fired with stokers are discussed in 16-page bulletin 102E. Diagrammatic layouts of both applications are included along with photos and full descriptions of the instruments needed. Bailey Meter Co.

(Continued on page 143)

NOW more important than ever to you

You are, or may soon be, shifting your production setup to meet the country's rearmament needs. New machines, new operations, and faster production schedules will demand some revision of your lubrication practices. That's why Standard's Service-Supply organization is now more important than ever to you.

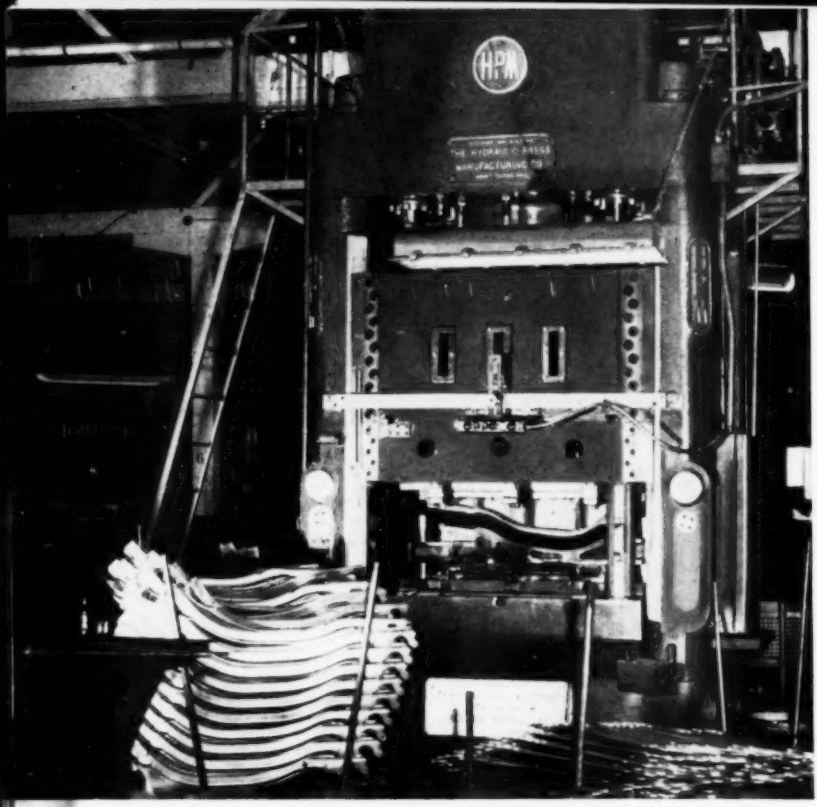
Standard has a service-supply warehouse within a short truck-hauling distance from your plant.

If you are a Standard Oil customer this warehouse will stock every lubricant used in your plant. Deliveries can be made in a few hours if necessary.

In addition, this service-supply center is headquarters for a Standard Oil lubrication specialist who is assigned to your plant. He is close at hand to give you help when you need it. He has plenty of practical experience. He has been specially trained for his job in a Standard Oil Lubrication Engineering School. He is backed by Standard Oil's extensive research and technical facilities.

To arrange for his visit, phone your nearby Standard Oil Service-Supply center or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD



What's YOUR problem?

D. G. Cripps, of Standard Oil's Grand Rapids, Michigan, office, is the Standard Oil lubrication specialist who recommended STANOIL for use in the hydraulic press shown at the left.

Complete familiarity with job requirements and lubrication applications equips a corps of such Standard Oil lubrication specialists throughout the Midwest to handle similar problems for plant operators.

One of these lubrication specialists is near your plant – ready to give you the benefit of his experience and training. You can obtain his services quickly and easily. Just phone or drop a card to the nearest Standard Oil Company (Indiana) office. Ask the lubrication specialist to explain the benefits of such widely accepted lubricants as:

SUPERLA Greases—Available in all consistency grades, SUPERLA Greases cover a wide range of applications. These products are comparable in quality to the highest type of special greases but are as readily available and economical as ordinary cup greases.

CALUMET Viscous Lubricants—On open gears and wire rope, these greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of gears and chains, better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specifically developed for its intended use. The grades range from a finger print remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

Gain these benefits for your hydraulic operations

The big 400-ton hydraulic press shown above is used to stamp out parts for farm machinery in a big midwest plant.

When the press was first put into operation, plant operators followed the recommendation of a Standard Oil lubrication specialist and used STANOIL Industrial Oil in the hydraulic system. In over four years of continuous hard service, there has been no lost time because of inefficient performance of the hydraulic oil.

Oil capacity of the system is approximately 9 barrels; only 2 barrels make-up per year has been required. The oil in this system has never been changed. It has been centrifuged once to remove moisture which accumulated over three years' operation. Periodic tests of oil samples have shown that STANOIL has maintained its high lubricating quality. A recent analysis showed no increase in viscosity of the oil, no change in color, and a neutralization number of only 0.13 mg. KOH/gm.

You can rely on this unique many-purpose oil to give you the same clean, dependable service in your plant's hydraulic systems, speed reducers, head stock gears, auxiliary turbines, compressors, and electric motors. You can rely, too, on the expert, on-the-spot service of a Standard Oil lubrication specialist. How you can obtain his help, quickly and easily, is explained at the right.

STANOIL
TRADE MARK
Industrial Oil

Standard Oil Company, 910 So. Michigan, Chicago 80, Illinois.

STANDARD **STANDARD OIL COMPANY (INDIANA)**

—ONE JOHN ZINK JZ STOP—
BURNER SERVICE

THERE'S A JOHN ZINK BURNER FOR EVERY HEATING and POWER NEED

John Zink and his engineers manufacture more than FIFTY TYPES of gas burners, oil burners and combination burners for domestic boilers, heating boilers, industrial boilers and power boilers. The designs are protected by TWENTY United State Letters of Patent.

•

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COMBINATION GAS & OIL BURNERS FOR EITHER VERTICAL or HORIZONTAL FIRING

SERIES CBM

Full rating may be taken with completely satisfactory fires with either fuel.

Both fuels may be fired in combination if necessary.

A new file and register design permits operation at low excess air.

Any gaseous fuel at pressure in excess of 5 lbs. may be burned.

Any commercial grade of fuel oil may be burned when properly prepared.

CBM

SERIES Y & SERIES YC

John Zink Series Y and YC Combination Gas and Oil Burners are particularly designed for boilers and process furnaces where maximum heat release at low excess air and high heat density place a premium on reliable burner performance at low first cost.

MAXIMUM DUTY — MINIMUM DRAFT.

RUGGED WEATHER-PROOF CONSTRUCTION.

SIMPLE IN DESIGN.

LIGHT-WEIGHT FUEL GUNS ARE EASY TO REMOVE.

BURN ANY COMMERCIAL FUEL OIL.

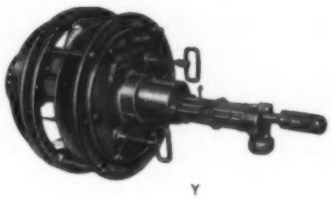
BURN ANY GAS AT REASONABLE PRESSURE.

DRAFT MAY BE NATURAL, INDUCED OR FORCED.

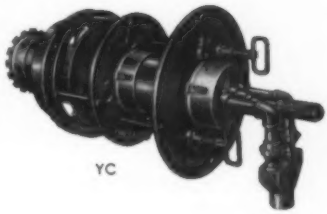
CHROMIUM ALLOY STEELS FOR HEAT & CORROSION RESISTANCE.

CENTER FIRING WITH BOTH FUELS ASSURES EQUALLY SATISFACTORY OPERATION WITH EITHER FUEL.

ANY AIR TEMPERATURE MAY BE USED.



Y



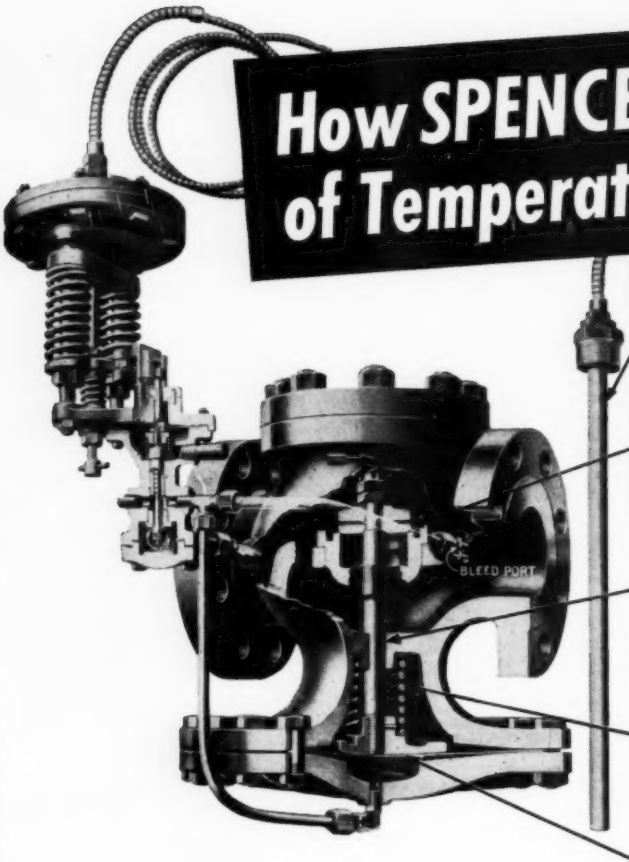
YC

WRITE FOR LITERATURE

JOHN ZINK COMPANY

4401 SOUTH PEORIA — TULSA, OKLAHOMA

How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

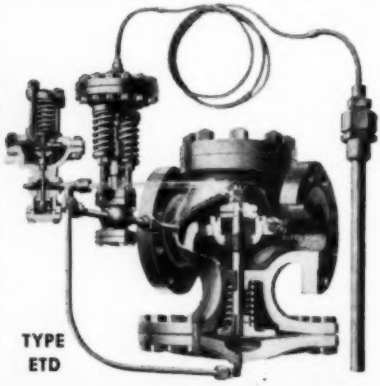
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.

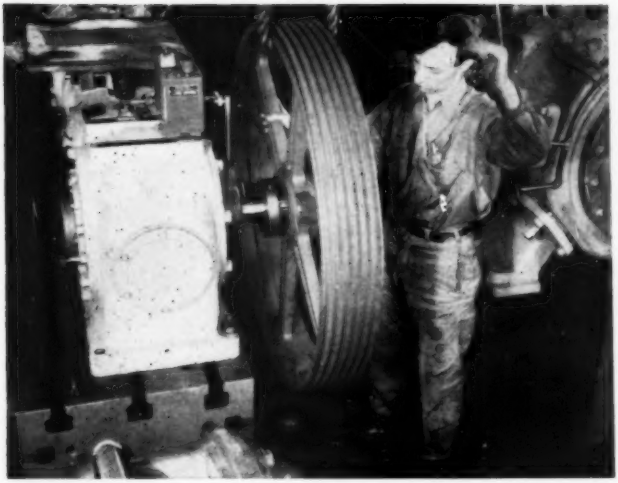


TYPE ETD

SE 111

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK



Pick the V-Belt Sheave

which all industry likes best

QD
TRADE MARK

Split hub is clamped to shaft. Heavier taper-bored rim slides easily over tapered hub—no keyway obstruction on cone surface. Positive press fit on shaft. Large, long pull-up bolts also used as jack screws to remove rim.

Here's a 26-word description of the V-belt sheave that is used more than any other.*

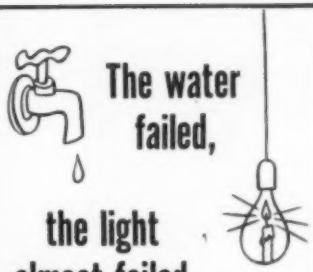
Two parts for easy handling—separately or together. Split hub and tapermated rim make mounting easy. No realignment problem—clamped hub stays put while changing rims.

That's Worthington's QD—the original tapered cone-grip sheave that's preferred by men who have to install or change sheaves. The QD is *easy to get on, easy to get off, yet always tight on the shaft* —tighter than any other sheave on the market. Hubs for every bore—lower inventory cost.

For your machines, pick Worthington Multi-V-Drives with QD sheaves and Worthington-Goodyear EC Cord V-belts.

Complete range of stock sizes—prompt shipment from distributors everywhere.

**In addition to being one of the largest-selling sheaves, the popular Worthington QD design is licensed to many other sheave manufacturers. For your protection, dimensions are standardized to permit interchangeability.*



but the distributor "came through"

A hydro-electric plant, crippled by drought, was threatened with losing its franchise; was given 60 hours to bring its service up. Two Diesel engines were about to arrive when somebody remembered to order the V-belt drives.

A call to **Anderson-Crane Rubber Company**, Worthington distributor in Minneapolis, located four large D-section QD sheaves and 25 Worthington-Goodyear steel cable V-belts. These were rushed by car at night to the power plant, arriving just ahead of the engines. Within 24 hours, the plant was producing full power.

Once again, the Worthington distributor was *on the job*—with the needed supplies and the prompt service!

WORTHINGTON

THE GOOD RIGHT HAND OF INDUSTRY

POWER TRANSMISSION: sheaves, V-belts, variable speed drives

PUMPS: centrifugal, power, rotary, steam

AIR COMPRESSORS: water-cooled, air-cooled

Worthington Pump and Machinery Corporation
Multi-V-Drive Sales Division
Buffalo, New York

Send Bulletin V-1400-B7F on Worthington Multi-V-Drives.

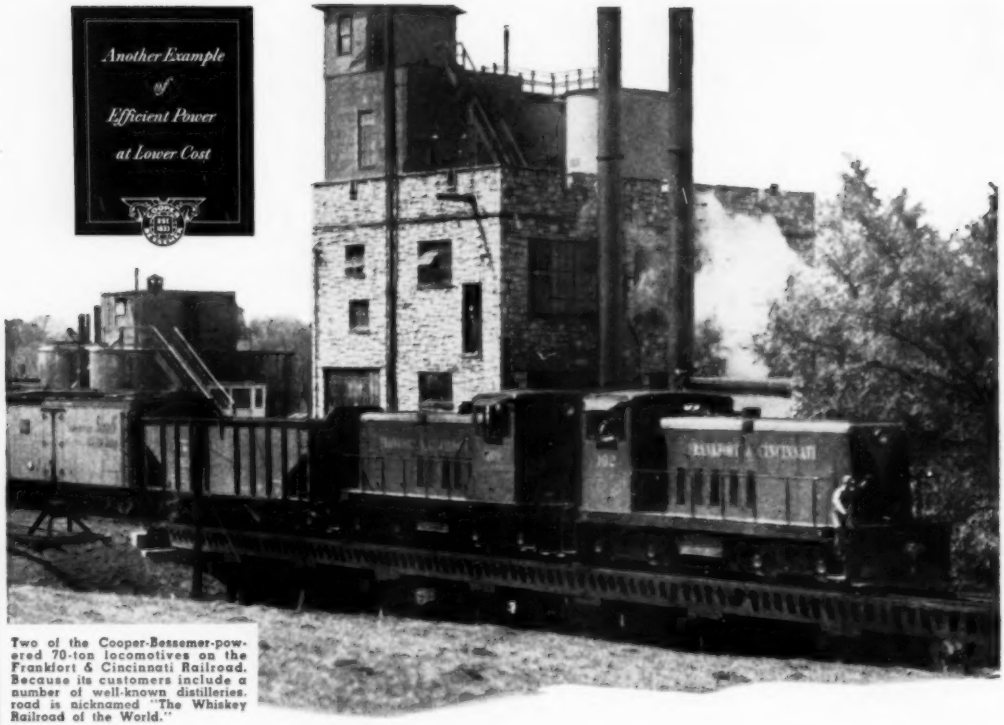
Name.....

Company.....

Address.....Zone....State...

MV.1.3

Another Example of Efficient Power at Lower Cost



Two of the Cooper-Bessemer-powered 70-ton locomotives on the Frankfort & Cincinnati Railroad. Because its customers include a number of well-known distilleries, road is nicknamed "The Whiskey Railroad of the World."

Maybe the diesels that "Saved a railroad" can help YOU cut costs

WHETHER your plans call for stationary, marine, or locomotive power, the facts in the case of the Frankfort & Cincinnati Railroad might be your cue to big savings.

On this short-line railroad, three Cooper-Bessemer-powered 70-ton diesel-electric locomotives are now doing the work of seven steamers. They are giving close to 98% availability! Maintenance cost has dropped from one-half to one-*fifth* of a cent per ton mile. Fuel costs run less than half! Net result is a *full 68% cut in operating costs!* In the words of George L. Fowler, president of the railroad, "If it hadn't been for the money saved by our diesels, our road just couldn't operate."

Here is a typical example of the steady work-loads that can be carried with unmatched economy and dependability by good diesels — the kind built by Cooper-Bessemer for *all* types of heavy-duty service.

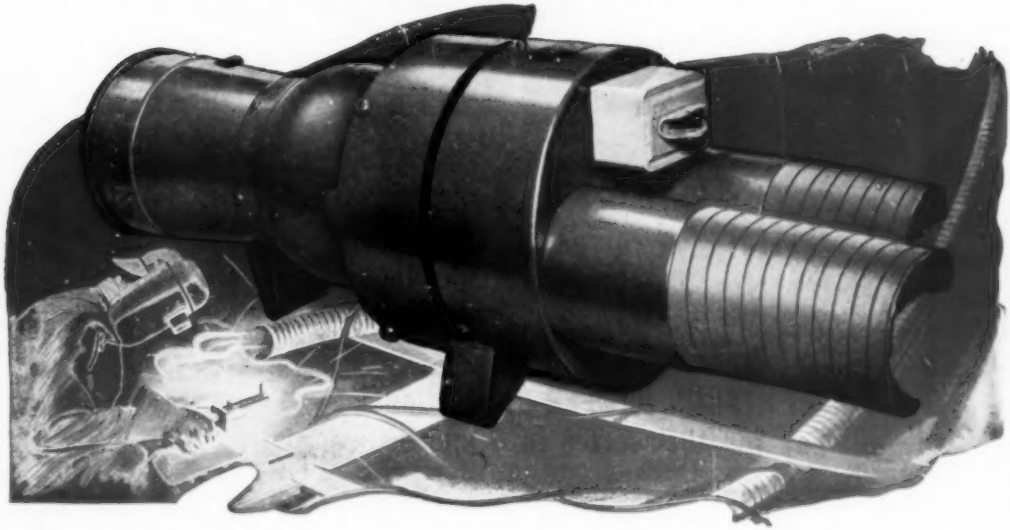
The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

An Extra Lung for A Man

HAVING TROUBLE BREATHING



The amount of work a man can do goes *down* when foul air comes *in* or the heat goes *up*. Are you giving your workers the equipment that will keep them efficient even when working in hot or noxious fumes?

Many concerns regard Coppus Blowers as "production tools" as well as "safety equipment". They help men to do more work and better work.

You can find in the Coppus line the right blower or exhauster for each "bad spot"—or perhaps one type will handle a variety of jobs. In addition to man-cooling and removing fumes from confined places, Coppus Blowers are used for cooling and drying materials and equipment. They are portable . . . efficient . . . built to Coppus "Blue Ribbon" standards of construction and workmanship in order to withstand severe usage.

Check and mail the coupon for specific information. Coppus Engineering Corp., Worcester 2, Mass.

Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP., 184 PARK AVENUE, WORCESTER 2, MASS.
Please send me information on the Blowers that clear the air for action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausters, welding fumes
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have).

We're not out to corner the DAMPER MARKET...

. . . we want HEACON DAMPER applications that will pay for themselves in 6 months.

The Heacon Damper is not just *another* damper. It is designed and engineered to provide the tightest closure possible under all conditions. Each damper is developed to solve a specific problem, each provides the ultimate in control.

The dampers shown on this page all solved specific problems that could have been solved in no other way.

As an example, the second damper from the left above, not only controls 80" w.g. pressure, but also acts as an automatic reverse flow valve that instantly closes and prevents leakage should one of two fans on the boiler fail. The next damper on the right isolates its air heater for maintenance while the boiler continues in service. Such applications save many times their cost, in time and power loss.

Call or write the office nearest you for full details.

THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.,
1440 St. Catherine St. W., Montreal 25, Quebec

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Leadon, Zachary & Peterson
302½ West Central

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416 Rhodes Building

BOSTON 10, MASS.
Holbrook & Hunter
88 Broad Street

BUFFALO 13, NEW YORK
The Johnston Engineering Co.
1200 Niagara Street

CHARLOTTE 2, N. C.
T. C. Heyward
1408 Independence Building

CHATTANOOGA 2, TENN.
Edgar A. Rogers
Chattanooga Bank Building

CHICAGO 6, ILL.
Cochrane Engineering Corp.
309 West Jackson Boulevard

CINCINNATI 2, OHIO
Ellman Equipment Co.
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Frank Howell Company
Room 412, American Bldg.

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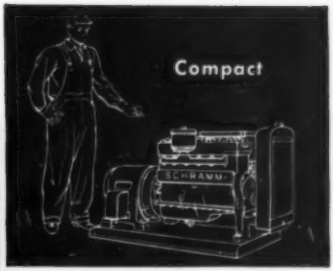
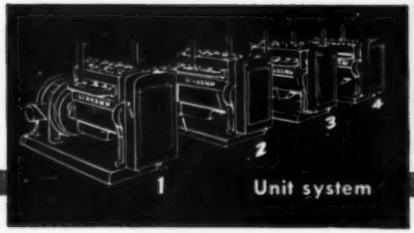
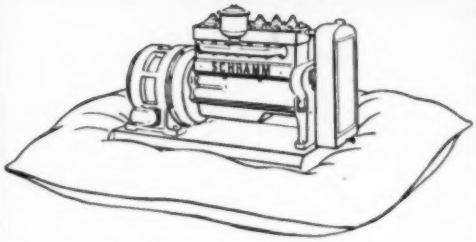
TOLEDO 4, OHIO
Metrol Company
518 Jefferson Avenue

WASHINGTON 5, D. C.
T. W. McGuire Company
1627 K Street, N. W.

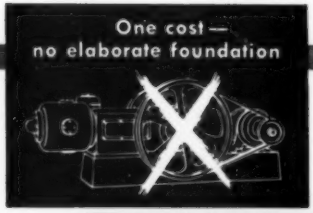


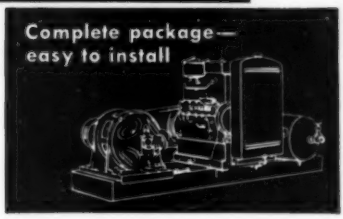




SCHRAMM

"VIBRATIONLESS" COMPRESSORS





VIBRATIONLESS

one of the many features of SCHRAMM AIR COMPRESSORS

. . . that make them ideal for INDUSTRIAL APPLICATIONS

SCHRAMM stationary air compressors are the only stationary compressors so free from vibration that they can be operated without an elaborate foundation by simply grouting and bolting to the floor.

Perfect balance of pistons and connection rods, the heavy rigid crankshaft supported on a substantial bearing between each cylinder, and vertical in-line construction, makes for vibrationless operation.

This feature you will find of value when it comes to smooth running, 24 hour heavy duty service, in all sizes ranging from ⅓ to 100 h.p.

Feature for feature, Schramm offers more. Get all the Schramm advantages by writing today for our bulletin C-50B.

SCHRAMM INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

SCHRAMM, INC.
WEST CHESTER, PA.

Please send Free Booklet C-50 B on installing Stationary Air Compressors.

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Just Out!

NEW 36-PAGE EDITION OF

PIPING POINTERS

...a bigger, more helpful handbook for training maintenance workers

You asked for ¼ million copies of the last edition of Piping Pointers. You found it a big help in training beginners and refreshing veterans in your piping crews. The bigger and better edition is just out—changed in appearance but not in purpose. Crane again offers this booklet—to help keep your piping systems at peak efficiency.

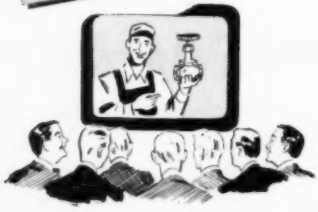
Piping Pointers talks facts . . . not theory. Thoroughly covers the fundamentals of good, sound, everyday piping practices . . . in easy-to-grasp, nontechnical language. Its many "how-to-do-it" features are illustrated for easy understanding.

Mistakes in piping installation and maintenance cost more today. Piping Pointers can help your men avoid them. Just ask your Crane Representative for a copy.

PARTIAL INDEX TO PIPING POINTERS

HOW TO choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

plus THE CRANE VALVE SELECTION GUIDE which saves time and effort in selecting valves for common piping services.



PIPING POINTERS 16-mm SOUND FILM
Free Usage for Group Training

A 30-minute motion picture that dramatizes the fundamental information in the Piping Pointers Manual. Ideal for classroom or plant training groups. Available on request through your local Crane Branch.

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CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

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STOP

FREE SURVEY: Place your rust problems in the hands of a RUST-OLEUM specialist. He will survey your plant for all rust problems, submit detailed recommendations, and make specific tests.

You can stop rust with RUST-OLEUM! An exclusive formula proved in a wide range of industrial and marine applications for more than 25 years. Its tough, pliable film dries to a firm rust-resisting coating that protects against rust—cuts maintenance costs—adds years of use to many metal surfaces, indoors and outdoors.

RUST-OLEUM may be applied over rusted surfaces without removing all the rust, assuring substantial savings in preparation time... It is only necessary to remove all the rust scale and loose rust.

Prompt delivery from Industrial Distributor stocks in principal cities. See *Sweets* for complete catalog and nearest source of supply, or write for complete literature on your company letter head today!

Beautifies AS IT PROTECTS

Available in many **COLORS,** aluminum and white

RUST

"Rigid Economy, Mon"

RUST-OLEUM CORPORATION

2471 Oakton Street, Evanston, Illinois

PREST-O-LITE Torches provide a high-temperature flame instantly.

At a flick of the lighter, a full-heat flame is ready for work.

INTENSE HEAT...

ready for instant use

A flame temperature as high as 2,800 degrees Fahrenheit—heat to spare for all of your soldering, heating, and light brazing—can be produced by any PREST-O-LITE Torch, using PREST-O-LITE Gas.* Yet complete control of this intense flame is always at your finger tips. A turn of a needle valve gives you the *exact* flame for the job.

Indoors or out, PREST-O-LITE Torches give a clean, full-heat flame the moment you open the valve and light the gas—no pumping, priming, or warmup is ever needed. They're light . . . easy to handle, even in hard-to-get-at places. And there's no waste of fuel between jobs.

Your jobber can show you how to do more jobs better, in less time, with PREST-O-LITE Torches. Ask him to demonstrate the many ways a PREST-O-LITE Torch can save you time and money.

Order from your local Jobber

or write us for his name and address. Linde Air Products Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, N. Y. 17, N. Y. In Canada: Dominion Oxygen Company, Limited, Toronto.

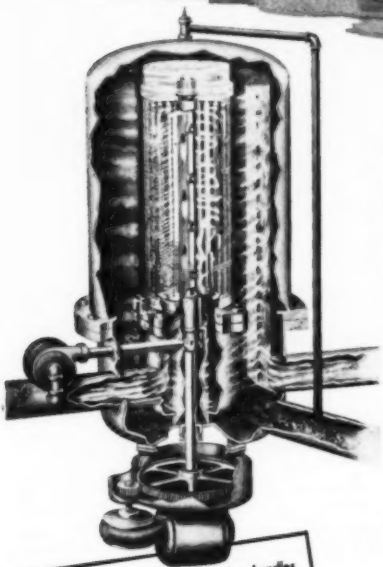
* *Prest-O-Lite* GAS
Trade-Mark

PREST-O-LITE Torches burn PREST-O-LITE Acetylene from small tanks in two handy sizes: B tank (40 cu. ft.), MC tank (10 cu. ft.) Tanks and refills are readily available from thousands of PREST-O-LITE Gas Exchange Stations throughout the United States and Canada. Return your empty tank to any station, get a full one back, and pay only for the gas.

MC TANK B TANK

The term "Prest-O-Lite" is a trade-mark of Union Carbide and Carbon Corporation.

QUICK, HENRY, THE FILTER!



Permanent wire-wound cartridge handles full flow. Continuously self-cleaning—no flow interruptions. All-metal construction is abrasion- and corrosion-resistant.

If water's getting scarce in *your* area . . . use river or lake water for industrial purposes. Make it fit for those purposes by straining through a Cuno FLO-KLEAN Strainer to remove trash.

RECIRCULATE PROCESS WATER

Clean process water for re-use by passing it through a Cuno FLO-KLEAN—*guaranteed* to remove all solids larger than specified*, with negligible drop in pressure.

Even the FLO-KLEAN falls in with the spirit of saving water. Its cartridge cleaning system recycles the backwash—no waste.

INSTALL AND FORGET

The FLO-KLEAN takes care of its own cleaning, too. With continuous cartridge backwash cleaning and automatic top and bottom blow-down, it can be installed in a remote place and forgotten.

SAVE MONEY—AS WELL AS WATER

Some users have saved enough on water bills to pay the cost of FLO-KLEAN in a matter of *months!*

Send the coupon for full information on water-saving, money-saving FLO-KLEAN strainers.

**Available spacings from .0025 to .030 in. (220 to 20 mesh equivalent)*

FIND OUT HOW TO MAKE FLUIDS COME CLEAN AT LOWEST COST

CUNO

Complete Line *Fluid Conditioning*

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (Micro-Klean) • DISC-TYPE (Auto-Klean)
WIRE-WOUND (Flo-Klean)

Cuno Engineering Corporation
141 South Vine St., Meriden, Conn.

Please send information—without obligation—on Cuno FLO-KLEAN for application noted:

.....

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Name.....Title.....

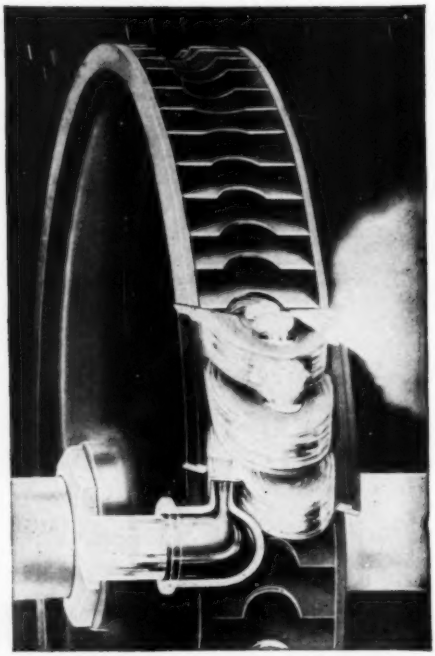
Company.....

Address.....

City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

TERRY



Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

NO PARTS TO LOOSEN OR WORK OUT

The rotor of the Terry Wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

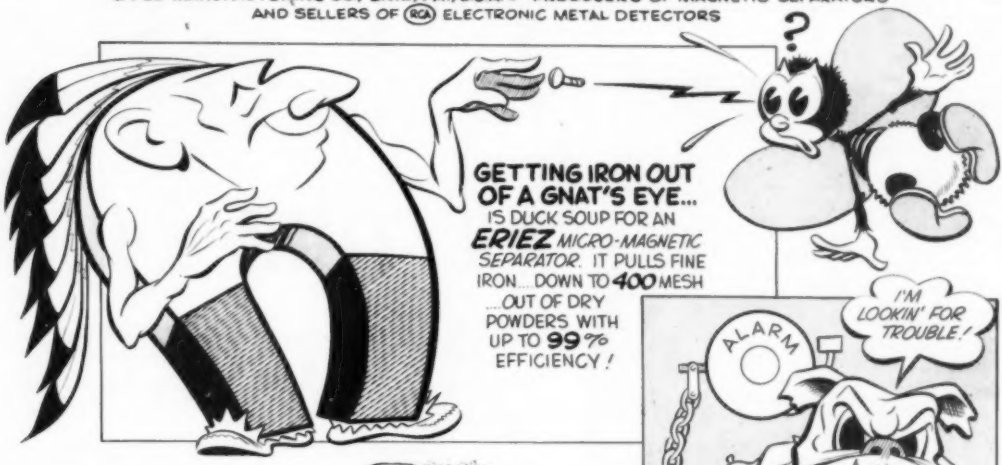
The power-producing action of the steam takes place on the solid curved backs of these buckets or pockets. Therefore close clearance is unnecessary and wear on the blades forming the pockets is of little consequence, as it does not materially affect horsepower or efficiency.

For detailed information about this effective construction and its advantages, write us on your business letterhead for a copy of Terry Turbine Bulletin S-116.

T-1172

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

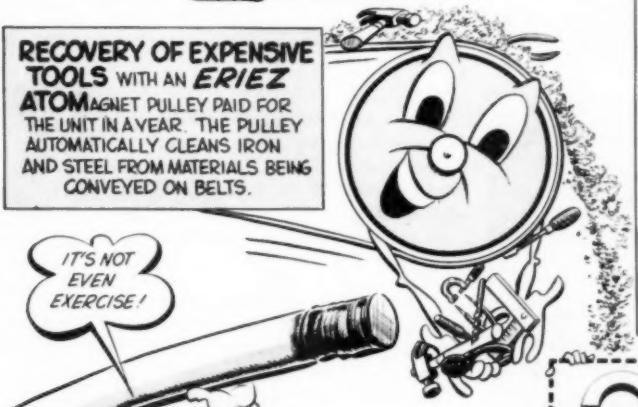
ERIEZ MANUFACTURING CO, ERIE, PA., U.S.A. • PRODUCERS OF MAGNETIC SEPARATORS AND SELLERS OF (RCA) ELECTRONIC METAL DETECTORS



GETTING IRON OUT OF A GNAT'S EYE... IS DUCK SOUP FOR AN ***ERIEZ*** *MICRO-MAGNETIC SEPARATOR.* IT PULLS FINE IRON... DOWN TO **400** MESH ...OUT OF DRY POWDERS WITH UP TO **99%** EFFICIENCY!

THE **R.C.A.** METAL DETECTOR, SOLD BY ***ERIEZ***, IS AN **ELECTRONIC WATCHDOG** THAT SPOTS ANY KIND OF METAL IN ANY KIND OF NON-METALLIC MATERIAL OR PACKAGE. WARNS BY GONG OR LIGHT, OR REMOVES THE CONTAMINATED PACKAGE.... ***AUTOMATICALLY!***

RECOVERY OF EXPENSIVE TOOLS WITH AN ***ERIEZ*** **ATOM**AGNET PULLEY PAID FOR THE UNIT IN A YEAR. THE PULLEY AUTOMATICALLY CLEANS IRON AND STEEL FROM MATERIALS BEING CONVEYED ON BELTS.



AN ***ERIEZ*** PLATE-TYPE **ATOM**AGNET HAS MAGNETICALLY LIFTED A CIGARETTE WEIGHING **447** *TIMES* MORE THAN THE FERROUS PARTICLE HIDDEN IN IT! ...RESULTS ARE JUST AS STARTLING WITH OTHER PRODUCTS.

ERIEZ MANUFACTURING COMPANY
208 STATE STREET, ERIE, PA.

MY CONTAMINATION OR SEPARATION PROBLEM IS:

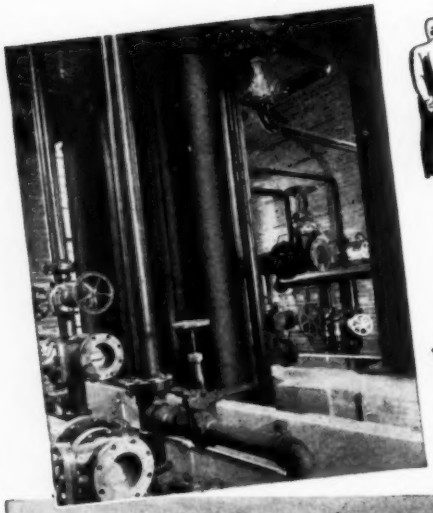
PLEASE SEND LITERATURE ☐
HAVE REPRESENTATIVE CALL ☐ PROMPTLY ☐ WHEN IN AREA

NAME _____
TITLE _____
COMPANY NAME _____
STREET _____
CITY _____ ZONE ___ STATE _____

51 F

Dirty Water can't "Shut-down"...

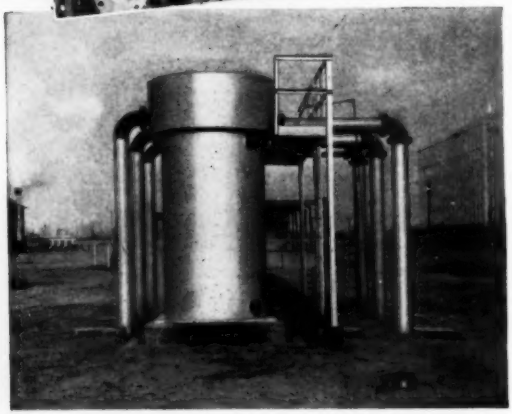
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

• **TOP:** *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

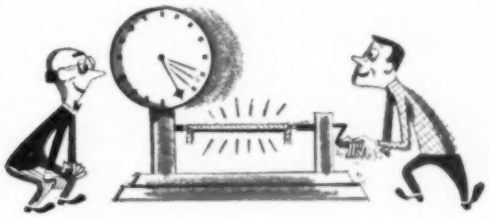
[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

From prehistoric times, ramie fiber has been known for its greater strength . . .

Now... Johns-Manville makes it into a packing of greater strength



That's why NAVALON lasts longer than other cold-liquid packings

LONGER PACKING LIFE . . . less down time . . . lower packing costs . . . it's the same story wherever this new Johns-Manville packing made from ramie is being used in cold liquid service.

And no wonder! Navalon has the high tensile strength inherent in ramie, strongest of all the organic fibers. It has the long-lasting, rot-resisting qualities for which ramie has been known for centuries. And it is made by an exclusive Johns-Manville process which imparts unusual lubricating properties as well—another reason why Navalon consistently outperforms other high quality packings in service against fresh and salt water, brine, cold oil and many other liquids.

If you have a tough packing problem in your plant . . . need a packing that will stand up and take it when other packings let you down, we suggest you give Navalon a try.

See your distributor today. Or send for folder PK-32A that gives further details about this new money-saving ramie fiber packing. Just fill in and mail the coupon below.

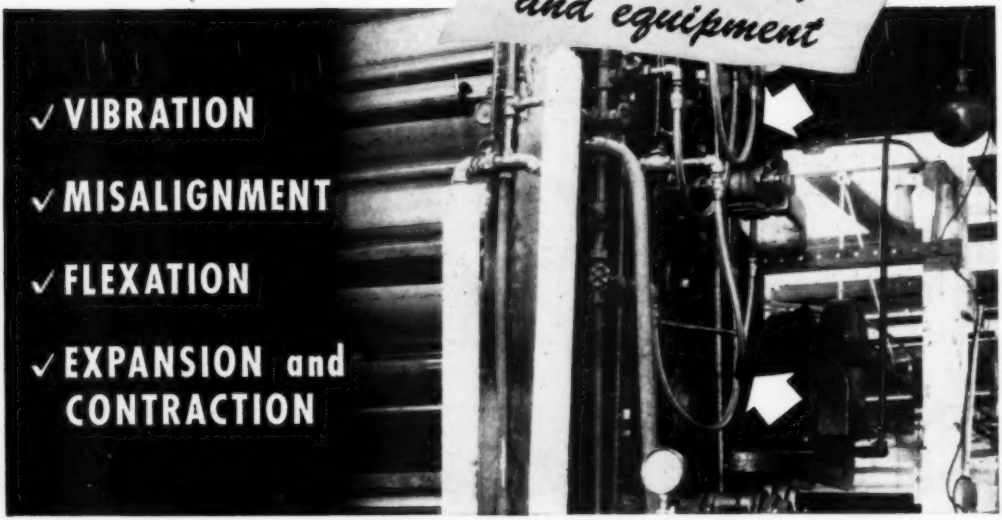
Johns-Manville
PACKINGS & GASKETS

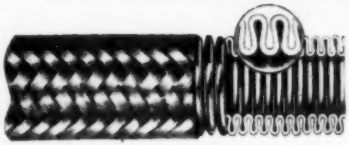
Johns-Manville
Box 290
New York 16, N. Y.
Please send me your folder on Navalon Packing (PK-32A).

Name_____
Company_____
Address_____
City_____ State_____

IP-6

Keep these *Dangerous* stresses *out of piping and equipment*





CMH Corrugated Flexible Metal Hose can be furnished in steel, bronze, stainless steel and other alloys. Depending on size, type and material, pressures up to 12,000 psi (burst) and temperatures up to 1600° F. can be handled.

CMH Convoluted Metal Hose is made in a variety of types and in steel, bronze and alloys. Depending on size, type and material, pressures up to 500 psi and temperatures up to 600° F. can be handled.

with CMH Flexible Metal Hose

MOTION or misalignment in rigid piping presents serious problems to the plant engineer. Piping subject to these stresses is in a potentially dangerous condition. In most cases these problems can be economically, dependably and safely solved by using CMH Flexible Metal Hose.

As a manufacturer of a complete line of flexible metal hose, CMH can furnish the type of hose best suited to your needs. CMH distributors are located in principal cities. See your classified telephone directory or write for his name. If you would like to have literature describing the CMH line, write for it, mentioning the types of connection problems you have.

Flexon identifies CMH products that have served industry for over 49 years.

CHICAGO METAL HOSE Corporation

1335 S. Third Ave. • Maywood, Ill. • Plants at Maywood, Elgin, Rock Falls, and Savanna, Ill.
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ont.

CMH

ONE DEPENDABLE SOURCE
for every flexible metal hose requirement

Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems
Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

What Day This Month Will Corrosion Knock Out Your Steam And Condensate Lines?

It can happen any day. *Corrosion* may be active in your plant *now*—in your steam and condensate lines, your process equipment—ready to destroy!

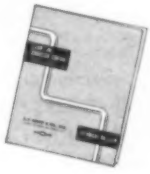
But whatever day failure occurs . . . you can be sure of one thing. It's going to be expensive! Many times more costly than *proper* corrective treatment.

Drew prevents corrosion by a study and investigation of *your* plant operations and water conditions. It analyzes those conditions in its modern laboratories and *insures* improvement of operation by specific recommendation for corrective treatment.

Thoroughness of investigation and proper treatment have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew's Boiler Water Treatment and Steam Line Corrosion Control. Do the same. Consult the nearest Drew engineer or write for further information.

Have the Drew engineer check the corrosion in your plant with a corrosion tester.

Send for Technical Bulletin on Steam Line Corrosion Control. Write for your copy today.



POWER DREW CHEMICALS

Power Chemicals Division

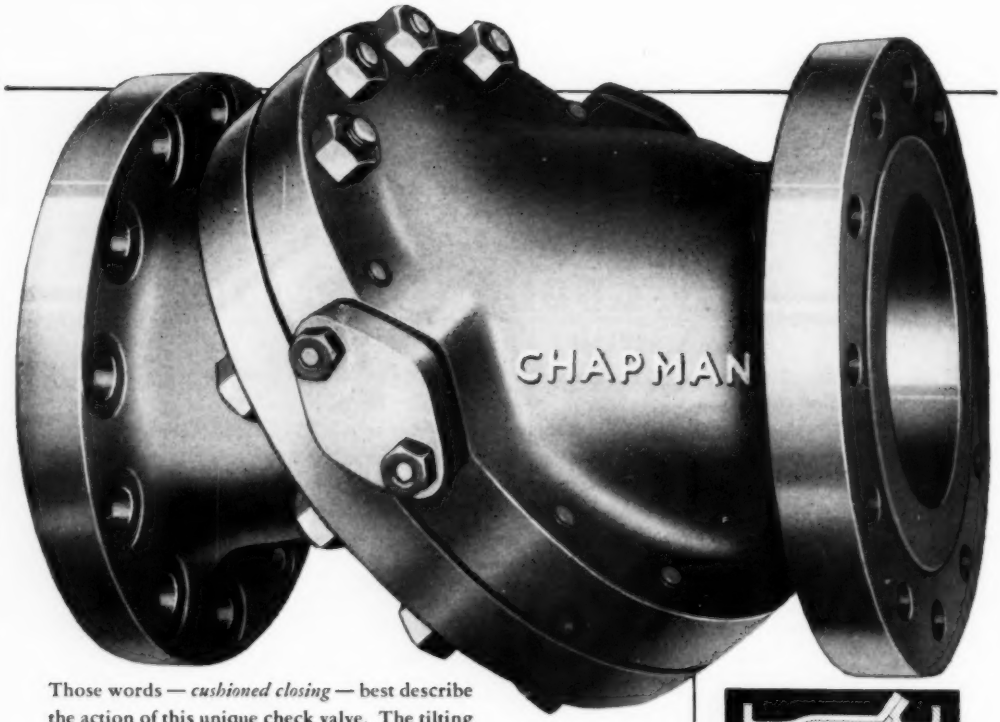
E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

DREW PRODUCTS

Nationwide Service in Boiler Water and Cooling Water Conditioning

Stop Expensive Slamming With the Cushioned Closing of CHAPMAN TILTING DISC Check Valves

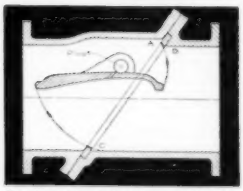


Those words — *cushioned closing* — best describe the action of this unique check valve. The tilting disc works with the stream—opens easily, closes quickly, *yet quietly.* There's no slamming — no resultant destructive stresses on the pipeline.

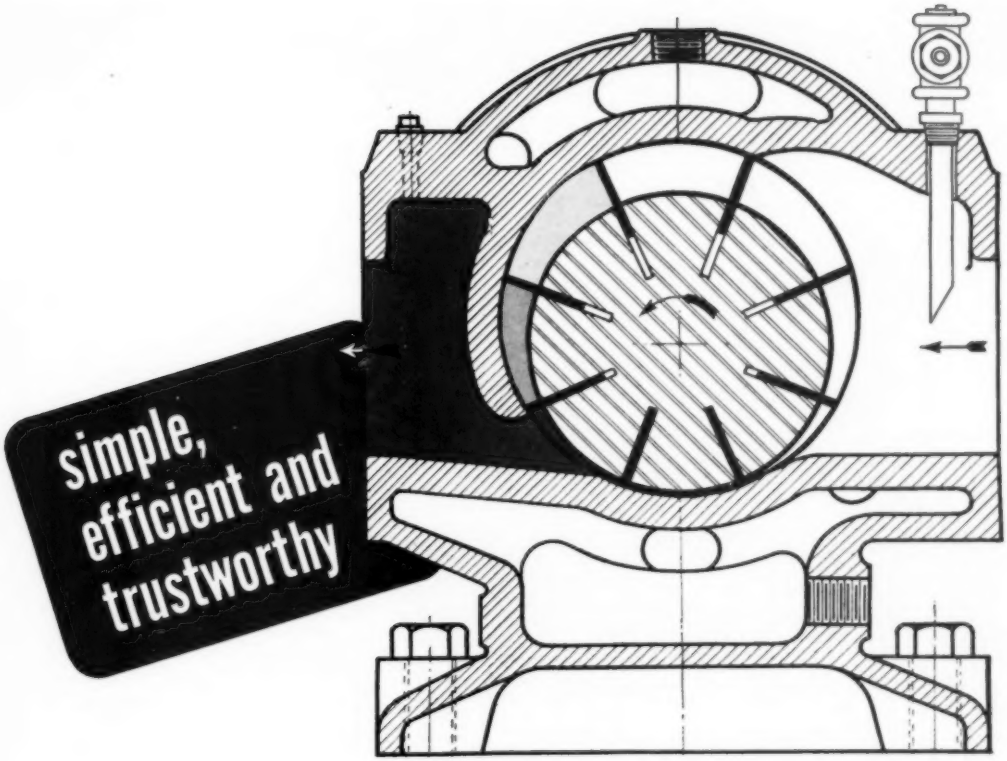
As a result of this smooth, *cushioned action*, maintenance costs are at a minimum and savings of from 65% to 80% in head losses can be obtained over conventional-type check valves.

Send today for the bulletin describing this unusual valve.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.



the FULLER ROTARY COMPRESSOR

For compressing gas, no reciprocating compressor can compare in simplicity and operation with a rotary.

PRINCIPLE IS SIMPLE

An eccentrically mounted, accurately machined rotor, with integral shaft, is supported on roller bearings in each of the heads. The eccentric rotor mounting leaves a crescent-shaped space, which is divided into compartments by wear-compensating blades. These slide freely in milled slots in the rotor, and are held, pressure tight, against the cylinder solely by centrifugal force. These compartments vary from minimum to maximum on the suction side, and from maximum to minimum on the compression half of the revolution. Properly designed blades, and a wide seal between rotor and bottom of cylinder, assure high and **maintained** volumetric efficiency; the multiple blades minimize pressure differences between compartments and contribute to maximum output with minimum wear.

OPERATION IS EFFICIENT

The Fuller Rotary Compressor assures a smooth flow, with no pulsations ... numerous displacement deliveries per revolution as against one in a single-cylinder piston compressor. Other advantages are: Direct drive; Compact installation; Simple foundations; Maintained capacity and efficiency; and No valves to leak. Because there are few moving parts—rotor, blades, and bearings, **maintenance time and costs are negligible.**

For further information on Fuller Rotary Compressors that will do a better job for you, write for Bulletin C-5.

Fuller

DRY MATERIAL CONVEYING SYSTEMS
AND COOLERS • COMPRESSORS AND VACUUM PUMPS
FEEDERS AND ASSOCIATED EQUIPMENT

FULLER COMPANY
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C-218

CLEAN STREAMS ARE BECOMING A REALITY IN OHIO AND PENNSYLVANIA

A FEW INFILCO INSTALLATIONS

1. Akron, Ohio—Clarifier—Rubber Wastes
2. Cleveland, Ohio—Cyclator®—Metal Finishing Wastes
3. Delaware, Ohio—Cyclator—Plating Wastes
4. Lockland, Ohio—Accelator®—Plating Wastes
5. Plain City, Ohio—Cyclator—Plating Wastes
6. Rockdale, Ohio—Cyclator — Asbestos Board Wastes
7. Sandusky, Ohio—Cyclator — Metal Finishing Wastes
8. Betzwood, Pa.—Cyclator—White Water
9. Bridgeport, Pa.—Cyclator—White Water
10. Conshohocken, Pa.—Cyclator — White Water
11. Erie, Pa.—Cyclator—Plating Wastes
12. Grove City, Pa.—Accelator —Hydroblast Waste
13. Johnsonburg, Pa.—Cyclator—White Water
14. Miquon, Pa.—Cyclator—White Water
15. Norristown, Pa.—Cyclator — Asbestos Board Wastes
16. Philadelphia, Pa.—Cyclator—Refinery Wastes
17. Reading, Pa.—Cyclator—White Water
18. Saegerstown, Pa.—Clarifier—Tank Car Washing Wastes
19. Spring City, Pa.—Cyclator—Bleachery Wastes

THESE INFILCO TREATING PLANTS ABATE POLLUTION TO MEET STATE BOARD REQUIREMENTS ECONOMICALLY

Ohio and Pennsylvania are making rapid strides in returning rivers and lakes to their natural state by cleaning up industrial plant effluents . . and Infilco Equipment is helping them to do it!

The industries shown here have found the installation of Infilco Equipment the *best* solution to their waste treatment problems. Many of the plants are recovering by-products or clarified water to defray operating expenses. Infilco can help *you* with *your* waste disposal problems with 57 years experience and a complete line of equipment for chemical and biological treatment. Call in the nearest Infilco field engineer or write to our Tucson offices.

Bulletin 70-A describes Infilco Equipment and its waste treatment applications. Send for it today.

SERVING INDUSTRY WITH WASTE TREATMENT EQUIPMENT THAT'S

Quality Engineered for Quality Performance

INFILCO

• BETTER WATER CONDITIONING AND WASTE TREATMENT SINCE 1894 •

INFILCO INC.

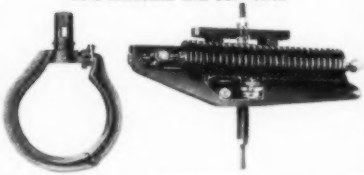
TUCSON, ARIZONA

WITH OFFICES IN PRINCIPAL CITIES

WORLD'S LEADING MANUFACTURERS OF WATER CONDITIONING AND WASTE TREATING EQUIPMENT

EVERYTHING FOR PIPING

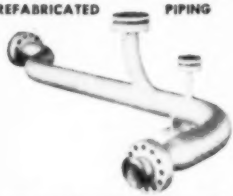
PIPE HANGERS and SUPPORTS



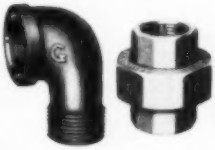
CAST IRON FITTINGS

WELDING FITTINGS

PREFABRICATED PIPING

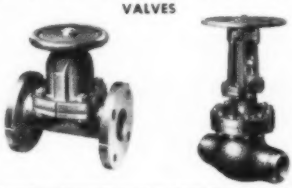


MALLEABLE IRON FITTINGS



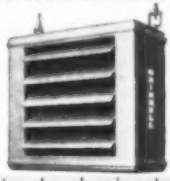
FORGED STEEL FLANGES

VALVES

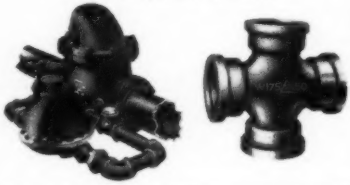


STEEL NIPPLES

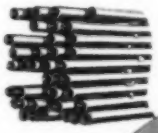
THERMOLIER UNIT HEATERS



WATER WORKS SPECIALTIES



PIPE



PLUMBING and HEATING SUPPLIES

Whatever your requirements for pipe, fittings, valves and other standard piping materials, you can get prompt delivery from a Grinnell warehouse or jobber. When the job calls for specialized piping products or installations, Grinnell has the manufacturing facilities, products, experience and engineering knowledge to "deliver the goods".

at your nearby GRINNELL Warehouse or Jobber

GRINNELL

WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

From Receiving Room...to the End of the Line

Trane Heating Serves Everywhere in Industry

Here are just a few of the answers to heat-handling problems that factory engineers have found in the Trane line.

Production Line Heating—A manufacturer of dairy equipment uses Trane Projection Heaters and Louver Cone Diffusers to send warmth down from the ceiling all along a production line. The vertical unit heaters and their completely adjustable diffusers throw heat 60% farther than ordinary units and could be mounted higher, above craneways and overhead equipment.

Draft Prevention—A metal products plant had a negative pressure that caused infiltrating drafts. Trane Heating Coils installed in a window opening, built up a positive pressure which blocked the drafts, solved the problem, kept the building comfortable.

Drying—An eastern sugar refinery was looking for a quick, economical way to dry out the burlap bags that the raw sugar came in. A long drying tunnel, racks for the wet bags, and floods of heat from a Trane Torridor gave the answer.

Supplying Cool Air—Forty autoclaves were generating a lot of heat in a North Carolina hosiery mill—too much heat. Trane Roof Ventilators were the answer. They draw cool air into the building as hot humid air is exhausted.

Perimeter Heating—An aircraft factory is usually a long building, and those long, drafty window areas were quite a heating headache to one western aircraft manufacturer. Trane Wall-Fin Heaters installed under windows blocked drafts, cut heat losses, cut the heating bill.

Whatever your factory heating, ventilating, cooling or air conditioning problem is, look for the answer in the Trane line.

Both Projection and Horizontal Unit Heaters with completely adjustable Diffusers send heat in *any* or *many* directions at once.

This powered Roof Ventilator is a complete factory ventilating system. It can ventilate, circulate, heat both outside and recirculated air.

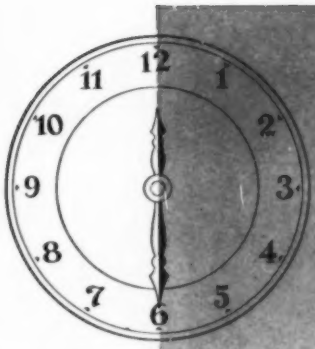
Easy-to-install Wall-Fin Heaters provide the ideal low-cost heating answer to window drafts and perimeter heating problems.

TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pennsylvania
Trane Company of Canada, Ltd., . . . Toronto
OFFICES IN 80 U.S. and 10 CANADIAN CITIES

$3,000



...for the half-hour that wasn't there

WHEN a Massachusetts company* surveyed their plant methods, they were amazed to find how much it was actually costing them to keep their machinery lubricated.

The lubrication cost was $14 every day. Added to that was the cost of the half-hour's production time lost every day while the machinery was stopped for lubrication.

This manufacturer called in an Alemite Lubrication Engineer. He recommended a system that *automatically* lubricated all the machinery . . . while it was running! The result: the lost half-hour was converted to productive time and the cost of lubrication was cut from $14 a day to only 21c a day. The total savings are over $3,000 every year.

Call Your Alemite Lubrication Engineer

No matter what size or type of plant you operate, Alemite can show you dozens of ways to save through the more efficient handling of petroleum products. Call your local Alemite Industrial Distributor now or send for the free booklet "11 Ways to Cut Production Costs." Simply attach the coupon below to your letterhead. Dept. M-61, 1850 Diversey Parkway, Chicago 14, Ill. *Name on request

ALEMITE

MEANS EVERYTHING FOR LUBRICATION

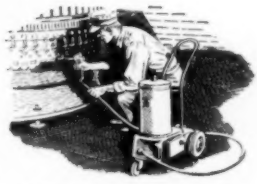
1. Methods 2. Lubricants 3. Equipment

Another Product of Stewart-Warner

Alemite Cuts Costs 3 Ways

1. In transferring lubricants . . . cuts man hours 63% for every 100 pounds transferred. Eliminates mess, costly contamination.

2. In loading grease guns . . . saves 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. In applying lubricants . . . saves up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

FREE! Valuable Booklet—

"11 Ways to Cut Production Costs"...

(Simply attach to your letterhead)

ALEMITE, Dept. M-61
1850 Diversey Parkway, Chicago 14, Ill.

We'll include facts on the new Alemite Oil-Mist System, too—(OIL-MIST atomizes oil into mist, circulates it to bearings under pressure. Increases life of bearings as much as 17½ times).

Name _____

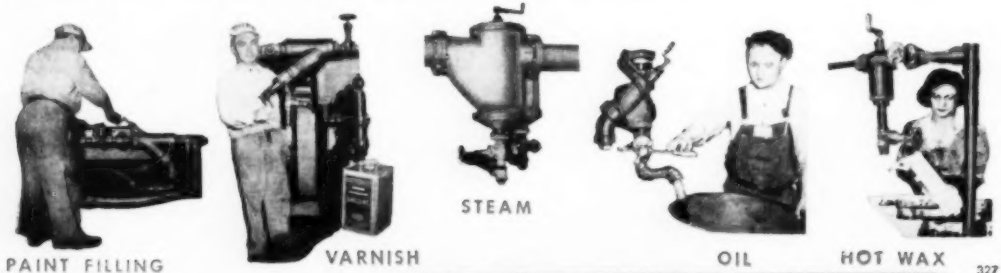
Company _____

City _____ *State* _____

The three six inch scraper strainers shown above are insuring a usable water supply 24 hours a day in this busy Detroit paper mill—it is river water which at times is full of debris. Pressure gauges tell the operator when the strainer needs scraping. Then, a few turns of the handles remove all material from the screens and the water pressure becomes normal again.

There are many uses for this Sarco product. Foods and chemicals are run through screens of varying sizes just before packaging. Hot liquids, such as wax and auto frame paint, are purified, and the exhaust steam containing lint from steam hammers is made suitable for use in unit heaters in a large Cleveland metal plant.

Scraper Strainers are available in sizes from ¾" to 8", up to 200 lbs. pressure, hand or motor operated. Bodies, screens and rotors can be made of any metal needed for the application. Ask for Catalog No. 1225.



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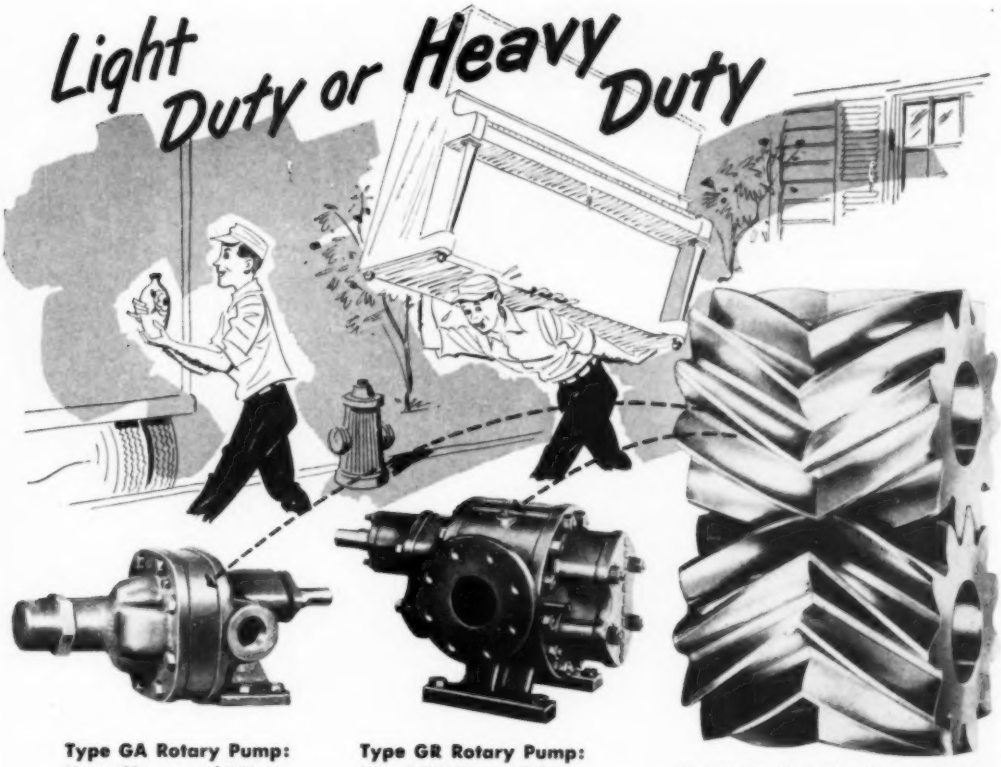
SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

Light Duty or Heavy Duty



Type GA Rotary Pump: Up to 50 gpm and 100 psi.

Type GR Rotary Pump: Up to 5000 gpm and 500 psi.

Double Helical Herringbone Gear Rotors: Quiet and efficient; extra large wearing surfaces; no axial thrust; no trapping of liquid.

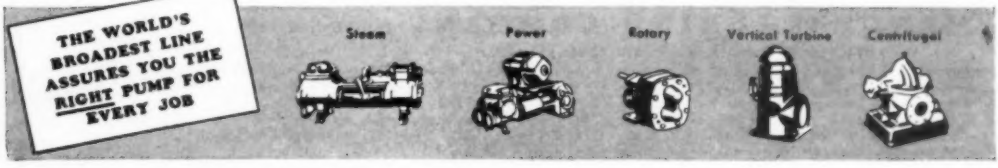
. . . You Get The Same Sturdy Construction!

For light duty pumping of hot or cold, thin or viscous liquids, use the Type GA . . . for heavy duty, hook up its big brother, the Type GR. Either way you're sure of the ruggedest construction and smoothest performance it's possible to build into a rotary pump. That's because both these hard working huskies incorporate the special herringbone rotors that operate so quietly and efficiently . . . combining with the whole advanced Worthington design for long, trouble-free, money-saving service. Get the whole story that proves *there's more worth in Worthington.* Write, describing your requirements to *Worthington Pump and Machinery Corporation, Pump and Compressor Merchandising Division, Harrison, New Jersey.*

WORTHINGTON

P-D-I

THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB



COAL ON THE MOVE

Jeffrey Belt Conveyors are used for long hauls—both horizontally and on the incline. Jeffrey Steel Apron Conveyors (left) for large capacities and short hauls. Both available in widths to suit requirements.

When most people think of coal they think of Jeffrey. That's a good habit to get into for Jeffrey moves a lot of coal in a year's time by some method or other. Two ways are shown here . . . two ways of moving large tonnages day after day.

If you want to speed coal (or other loose bulk material) on its way—tell us about it. Likely we have worked out the best possible way to do it, using hundreds of installations in the past. Your handling problem may be different. Give us a chance at it. Our engineers will be glad to help you. Write today.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

814 North Fourth St., Columbus 16, Ohio

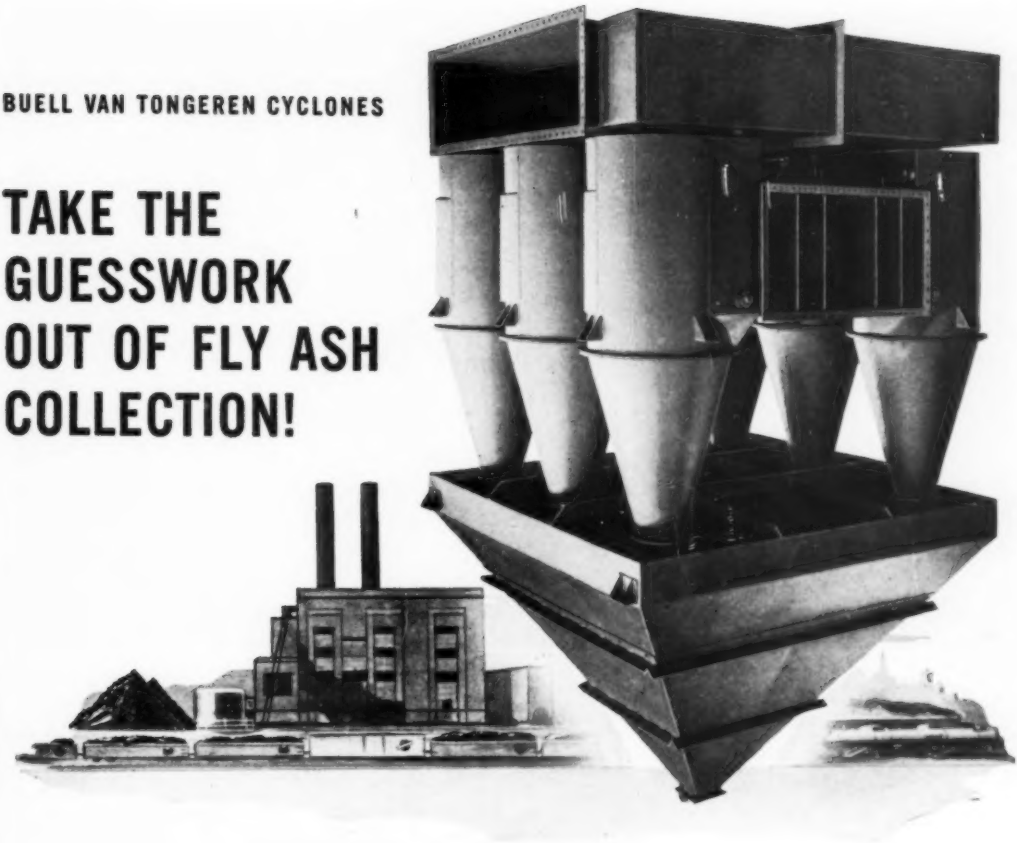
Baltimore 2 · Beckley, W. Va. · Birmingham 3 · Boston 16 · Buffalo 2 · Chicago 1 · Cincinnati 2 · Cleveland 15 · Denver 2 · Detroit 13 · Harlan, Ky. · Houston 2 · Jacksonville 2 · Milwaukee 2 · New York 7 · Philadelphia 3 · Pittsburgh 22 · St. Louis 1 · Salt Lake City 1 · Scranton 3

Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

BUELL VAN TONGEREN CYCLONES

TAKE THE GUESSWORK OUT OF FLY ASH COLLECTION!



Now you know beforehand that you can collect the nuisance-size particles from pulverized coal-fired boilers.

If you want a definite, dependable statement on the actual 'delivered' efficiency of a Fly-Ash Collection System, ask Buell.

Buell's van Tongeren Cyclone Dust Collector, with Guaranteed Fractional Efficiency, gives you an accurate estimate of collector performance *before* your installation is made. Guesswork is out! Known, sustained peak efficiency is in!

For sound counsel on either Fly-Ash Collection or Valuable Dust Recovery problems, Buell engineers can prove invaluable. Write today for a consultation without obligation, or ask for the latest Buell catalog which discusses Buell Cyclones, Low-Draft-Loss Collectors, and Buell 'SF' Electric Precipitators. Buell Engineering Co., 70 Pine St., Suite 5017, New York 5, N.Y.

buell

Engineered Efficiency in **Fly Ash Collection**

How to Turn Wastes into Profits

Recover valuable minerals from your Water Supply with Permutit Ion Exchange Equipment

Now you can recover valuable materials from your water supply and solve disposal problems at the same time. Ion exchange equipment helps you do this by removing undesirable impurities from solutions, by concentrating substances or fractionation of electrolytes.

Permutit equipment can recover copper, gold, platinum, silver, chromium, nickel, cadmium, zinc, tin and other metals from solution. Recoveries as high as 97% are realized.

Ion exchange is also useful in organic compound recovery such as nicotine recovery from the exhaust gases of tobacco dryers, tartrate recovery from winery wastes, and sugar recovery from citrus wastes . . . as well as in recycling the process water of paper mills.

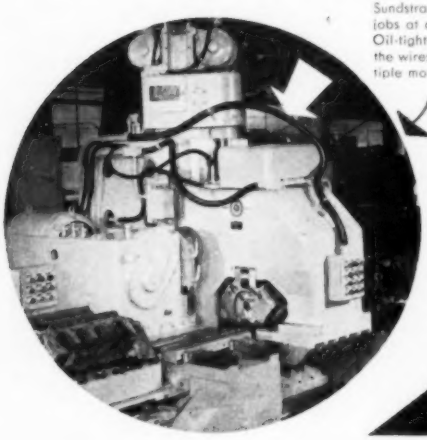
Why not put Permutit's 38 years of experience and complete line of water conditioning equipment to work to solve *your* waste problems? Write for full information to The Permutit Company, Dept. IP-6, 330 West 42nd Street, New York 18, N. Y.

PERMUTIT

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS

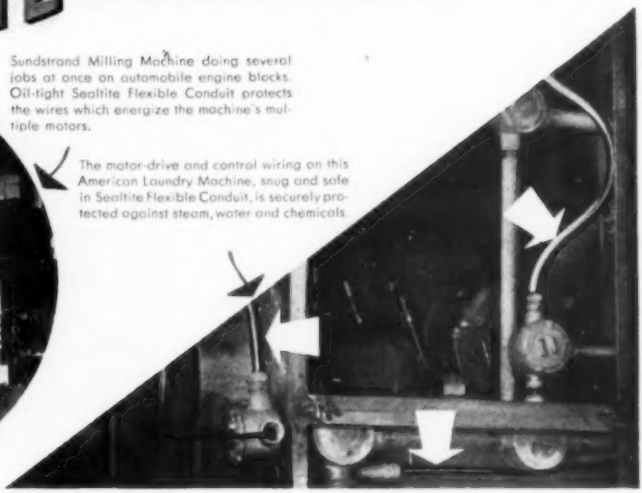
To make the wiring as good as the machine

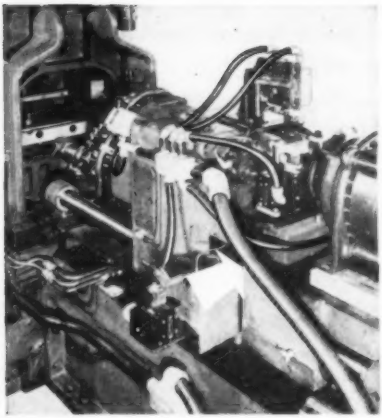
SEALTITE FLEXIBLE CONDUIT



Sundstrand Milling Machine doing several jobs at once on automobile engine blocks. Oil-tight Sealtite Flexible Conduit protects the wires which energize the machine's multiple motors.

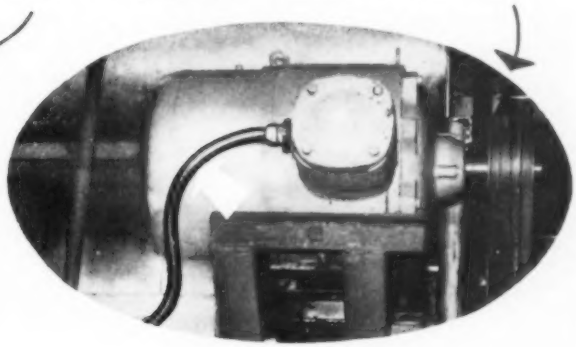
The motor-drive and control wiring on this American Laundry Machine, snug and safe in Sealtite Flexible Conduit, is securely protected against steam, water and chemicals.





Barnes "Automatic" machine tool for drilling and finishing automobile engine blocks. Sealtite Flexible Conduit carries wiring to motor and control relays operating machine turret.

Sealtite Flexible Conduit encloses motor leads on this California Packing Corporation canning plant conveyor . . . safeguards wiring from damage by fruit acids, provides flexibility for belt take-up.



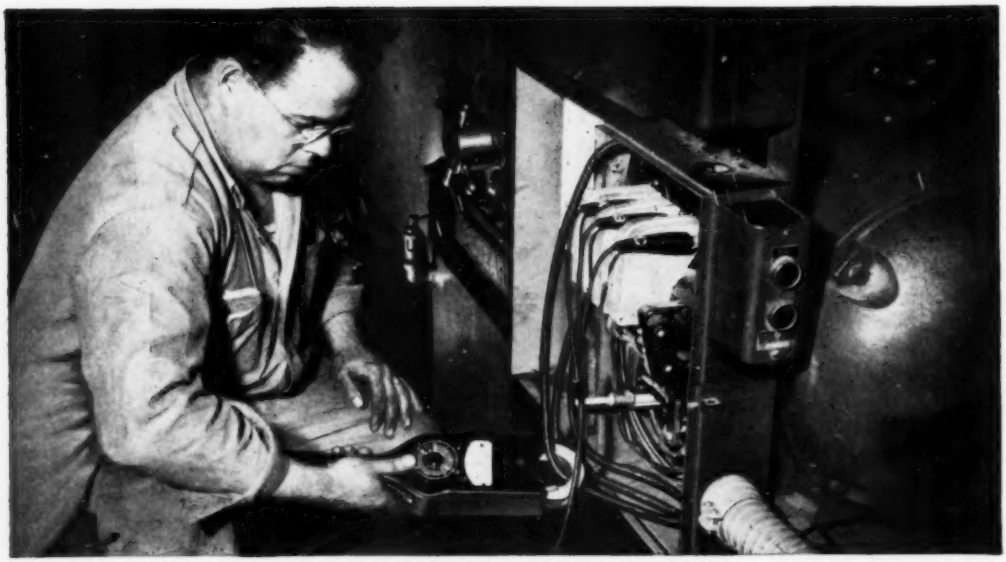
For sure protection of machine wiring, run it in Sealtite* Flexible Conduit. Sealtite – with a liquid-tight synthetic jacket over strong, flexible galvanized steel tubing – can resist impact, abrasion, oil, water, steam, chemicals, etc. Its flexibility simplifies connections, especially where small or infrequent movements are involved.

Sealtite comes in long random lengths, is easily cut and assembled on the job. It uses standard rigid conduit fittings, is available from your electrical supply house. Bulletin C-188 will tell you how Sealtite's flexibility can solve many wiring problems. Send for it now. The American Brass Company, American Metal Hose Branch, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

for **flexible, liquid-tight** electrical conduit . . . specify

SEALTITE AN ANACONDA® PRODUCT

*Trademark



WITH NEW GENERAL ELECTRIC AK-3 HOOK-ON POWER-FACTOR METER YOU CAN READ P.F. DIRECT—WITHOUT BREAKING CIRCUITS.

New Instrument Helps Apply Capacitors

FEEDER CAPACITY IS INCREASED by this 60-kvar capacitor unit installed at the Los Angeles Fiber Milk Container Plant.

Get 20 to 30% more feeder capacity this simple two-step way:

- **Measure your feeder circuits with the new G-E Type AK-3 hook-on power-factor meter**
- **On circuits which have low power factor, install G-E Pyranol* capacitors**

Capacitors are one of the quickest and least-expensive ways of increasing feeder capacity. They can permanently release up to 30 per cent more electrical capacity in your power system. This extra capacity is immediately available for new lighting and motor loads; no additional transformers or distribution equipment is needed.

If your power factor is now	you can release this much extra capacity	with this many capacitors*
65%	34%	84 kvar
70%	29%	69 kvar
75%	23%	55 kvar
80%	17%	42 kvar
85%	11%	29 kvar
90%	5%	15 kvar

*For each 100 kw of load. (Power factor raised to 95%).

With the new AK-3 hook-on power-factor meter you can read power factor quickly and accurately. Then with a table like the one above, you can readily determine how much capacity you can release and how many capacitors you will need. Also, the hook-on power-factor meter helps to pin-point those feeders with low power factor—tells you where to install capacitors for maximum benefits. List price of the AK-3 is only $84.75.

For more information contact your nearest General Electric representative, agent or distributor. Or, send the coupon today.

*Reg. Trademark of General Electric Co.

General Electric Co., Section B 407-205
Schenectady 5, N. Y.

Please send me information about the following products:

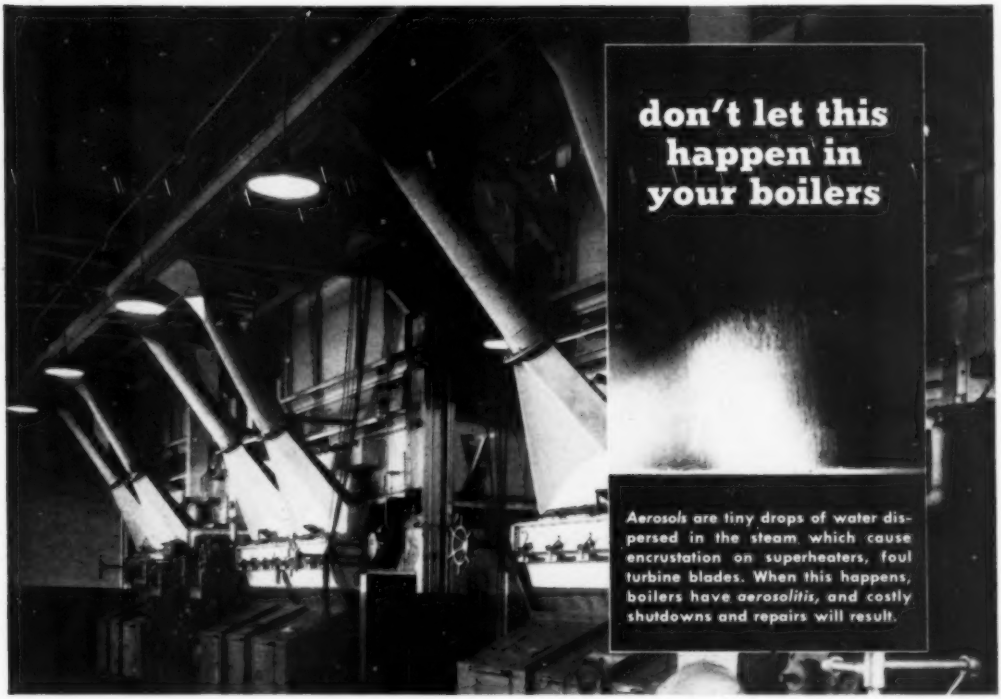
( ) Type AK-3 Hook-on Power-factor Meter (GEA-5469)
( ) Pyranol Capacitors (GEA-2742)

NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC


don't let this happen in your boilers
Aerosols are tiny drops of water dispersed in the steam which cause encrustation on superheaters, foul turbine blades. When this happens, boilers have *aerosolitis*, and costly shutdowns and repairs will result.

prevent aerosolitis

with Dearborn improved polyamide anti-foams

Your healthy looking steam boilers may be suffering from *aerosolitis* . . . the expensive boiler disease.

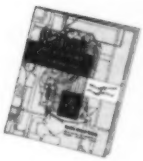
But *aerosolitis*, more prevalent with some waters than with others, is easy to cure with Dearborn Improved Polyamide Anti-Foams. In addition to inhibiting aerosol formation, Dearborn Improved Polyamide Anti-Foams prevent foaming to produce purer steam . . . eliminate scale formation . . . condition sludge . . . are compatible with other treatment.

If you use steam for power or process, investigate the time and money saving advantages of Dearborn Improved Polyamide Anti-Foams.

Please Note Our New Address

DEARBORN CHEMICAL COMPANY

Merchandise Mart Plaza • Chicago 54, Illinois



Write for Bulletins

Informative bulletins are available on (1) Dearborn Improved Polyamide Anti-Foams, and (2) Dearborn Industrial Water Treatment and Engineering Service. The coupon is for your convenience.

Dearborn Chemical Company, Dept. INP
Merchandise Mart Plaza
Chicago 54, Ill.

Gentlemen: Please send:

☐ Bulletin on Dearborn Improved Polyamide Anti-Foams.

☐ Bulletin on Dearborn Industrial Water Treatment and Engineering Service.

Name.....

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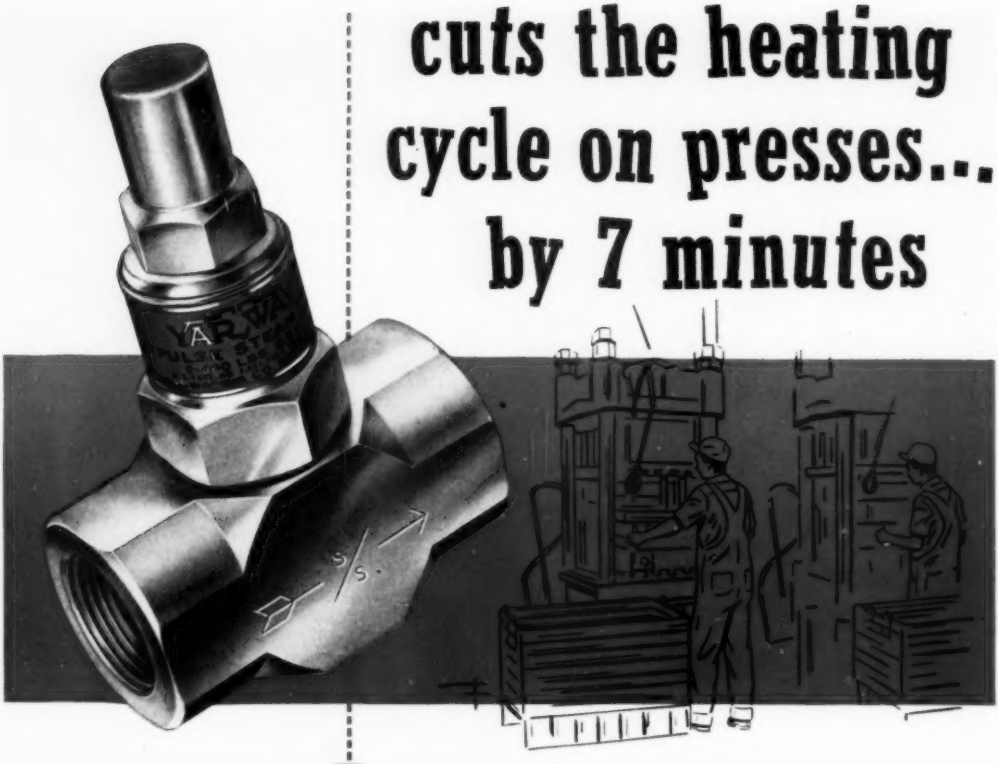
City.....*State*.....

Dearborn

TRADE MARK REGISTERED

THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

cuts the heating cycle on presses... by 7 minutes



PROBLEM: What to do when production requirements call for a speed-up in the heating cycle.

SOLUTION: (A typical one supplied by a western molded-rubber plant) Equip presses with Yarway Impulse Steam Traps.

RESULT: Heating cycle now 8 minutes instead of their usual 15, a saving of nearly 50%.

Yarway Impulse Steam Traps are designed **to get equipment hotter, sooner, and keep it hot**—thereby increasing production. In operation, Yarways send the most premium B.T.U.'s at top temperatures into your product or process.

Other reasons why over 750,000 Yarways have already been installed are—one moving part, low maintenance, small size, easy installation, good for all pressures, made of stainless steel, low cost.

It's easy to buy Yarway Impulse Steam Traps. One of 216 industrial distributors who stock and sell them is located near you.

FREE! NEW TRAP SELECTOR
The right steam trap in the right place is important. Find quickly and easily which *is* the right Yarway trap for each application in your plant. Write for your free copy of this new 16-page Selector.

YARWAY

the steam trap designed with production in mind

YARNALL-WARING COMPANY • 109 MERMAID AVENUE, PHILADELPHIA 18, PA.

INDUSTRIAL POWER

June, 1951 Vol. 60, No. 6

BUILDS WITH EYE TOWARD FUTURE

When the purchased steam source to this plant was cut off, steps were taken to design a power plant that would be flexible for any future expansion. Three 60,000 lb per hr boilers were installed, and space was allocated for a fourth unit. Each furnace is fired with a stoker

W. H. MOORE, *Superintendent of Maintenance*
Allis-Chalmers Mfg. Co., Tractor Division

THE Allis-Chalmers Mfg. Co., Tractor Div., Plant, located at La-Porte, Indiana just completed the first phase of its plant expansion. Three 60,000 lb per hr steam boilers are now on line supplying the present low demand of 80,000 lb of steam per hr, at 130 psig and 420 F TT. These boilers are the first of four that will be required to supply a future demand of 200,000 lb of steam per hr.

The plant heating and processing design load at the present time is 125,000 lb of steam per hr. The plan of operation at the La Porte plant for this reason is to base load one boiler and float the other with the third acting as a standby. The engineering group has gone all out to install standby equipment whenever it was possible.

Several years ago all steam was purchased from a local utility. This procedure, for numerous reasons, was not satisfactory. In the first place, little or no condensate was returned to the utility power station, and the ever increasing electrical power demand made it impossible for the utility company to meet commitments. In addition, the plant was placing a greater load on this steam source because they had expanded their facilities. The public utility eventually gave notice that it would be necessary to cut off the steam supply. The plant engineering group, in conjunction with C. W. Cole & Sons, Engineers, went ahead and not only planned a power plant, but future manufacturing facilities as well.

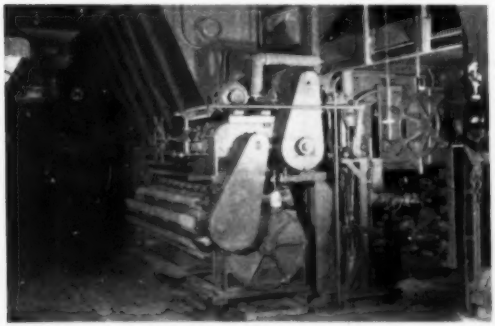
The three boilers just installed each have a furnace volume of 2,500 cu ft and heating surface of 8113 sq ft. Of this, 6930 sq ft is boiler surface and 1183 sq ft water wall. The boilers are equipped with superheaters and steam is heated to 420 F. Each unit is fired with traveling grate stokers equipped for complete overdraft combustion.

Two of the furnaces are equipped solely with electrically operated traveling grate stokers. One, however, is equipped with dual equipment that consists of an electrical motor and steam turbine driven stoker. In the event of an electrical outage this boiler can generate steam satisfactorily with the steam turbine operated grate. Draft is furnished by a forced draft steam turbine driven fan. The amount of air delivered to the furnace is controlled with automatic dampers on the fan inlet.

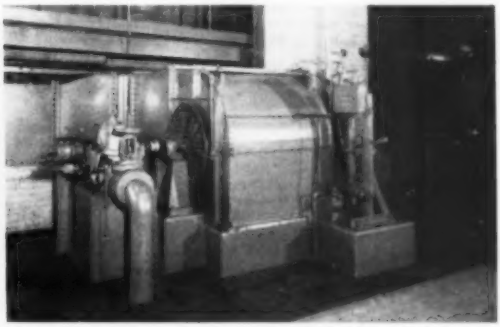
During the start-up of these boilers, they were fired as a gravity draft furnace. As steam pressure was increased, the steam turbines were operated and forced draft air was introduced to the firepits. In this way the pressure was built up to operate other auxiliary steam driven equipment.

Distribution System

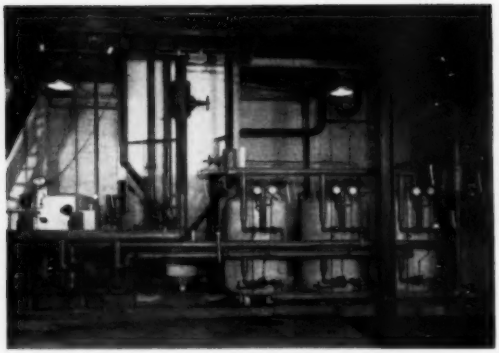
Steam is distributed through six pressure reduction stations located strategically in the plant. As the ma-



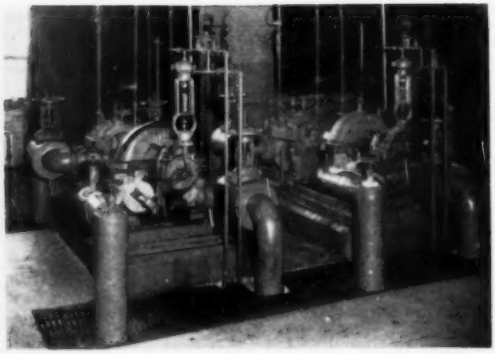
No. 2 boiler has been equipped with steam turbine and electrical motor drives to operate the traveling coal grate



Turbine driven FD fans turn at constant speed with vane controlled air volume through fuel-flow air-flow ratio



Water, of 14 gr as calcium carbonate hardness, is softened for boilers in this hot soda-lime process treatment system



Feedwater pumps deliver 300 gpm at 230 psi to the boiler drums. Turbines operate at 3580 rpm with 130 psig steam

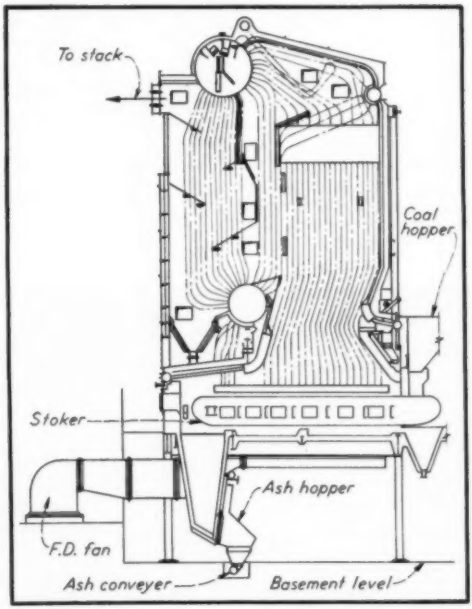
jority of the steam is utilized for plant heating, it is reduced from 125 to 15 psi. Process steam, however, uses line steam of 125 psi. Of particular interest is the length and complete network of steam pipes and returns. In fact, one main line extends under the New York Central Railroad to the main office building approximately six blocks away from the powerhouse. Condensate is returned to the powerhouse through six load stations. Approximately 80 per cent is mixed with treated make-up water to replenish the boilers.

Additional process steam will be utilized in drying ovens, which are at the present being installed. The old gas heated dryers have been discarded due to inefficient operation and difficulties in purchasing the large quantities of gas the units required.

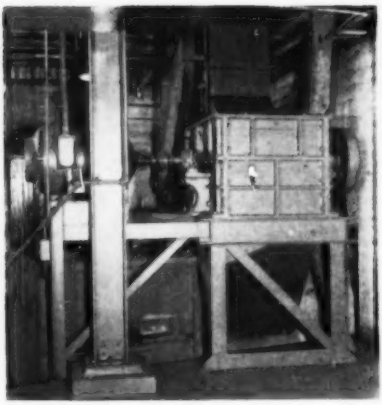
Ashes from the traveling grate are dumped into a hopper at the back end of the furnace. Removal from the hopper is by steam jet once during each shift. Ash is blown to an outside silo and stored until removed by truck. Soot blowers have been installed in the flues of the furnace that are operated with steam. Blowing of soot is accomplished once each shift. Fly ash that falls to the bottom of the smoke stack is ejected once a day by the steam jet system and collected in the ash silo. Before the ash is removed from the silo, it is wetted to reduce blowing.

BOILER PERFORMANCE AT THE LA PORTE PLANT

1	Pounds of steam per hour actual evaporation	15,000	60,000	67,500
2	Pounds of water per hour to unit	15,800	63,200	71,050
3	M Btu in steam above feedwater temperature	15,900	63,600	71,550
4	Total heat in water and steam above feedwater temperature including 5 per cent blowdown M Btu per hr	16,026	64,104	72,110
5	CO_2 in gases leaving furnace	13.0	14.5	14.5
6	Temperature of gases leaving furnace, F	—	1910	1990
7	CO_2 in boiler exit gases	13.0	14.0	14.0
8	Per cent excess air in boiler exit gases	42	30	30
9	Temperature of boiler exit gases, F	440	590	620
10	Temperature of air for combustion, F	80	80	80
11	Total steam temperature leaving superheater, F	428	440	443
12	Steam pressure drop through superheater, psi	1	7	9
13	Boiler drum pressure, psi	151	157	159
14	Draft loss through boiler and superheater	0.10	0.55	0.65
15	Furnace draft	0.10	0.10	0.10
16	Total static suction at exit (in. water gage)	0.20	0.65	0.75
17	Air pressure drop through ducts and dampers	0.1	0.7	1.0
18	Air pressure in wind boxes	2.0	2.4	2.6
19	Total static pressure at fan (in. water gage)	2.1	3.1	3.8
20	Pound of fuel per hr	1810	7400	8450
21	Pound of air per hr	21,600	79,200	90,400
22	Pound of gas per hr leaving unit	23,300	88,100	100,500
23	Overall efficiency complete unit	79.0	77.3	76.2
24	Heat release in furnace, Btu per cu ft per hr	8100	33,200	37,850
25	Pound coal per sq ft grate surface per hr	9.3	38.2	43.6
26	Dry flue gas loss at boiler exit	9.53	12.48	13.21
27	Loss due to hydrogen at boiler exit	3.88	4.10	4.15
28	Loss due to moisture in fuel at boiler exit	1.29	1.37	1.38
29	Loss due to radiation	3.40	0.85	0.76
30	Loss due unburned combustibles	1.40	2.40	2.80
31	Unaccounted for and leeway	1.50	1.50	1.50
32	Total losses	21.00	22.7	23.8
33	Efficiencies of complete unit	79.0	77.3	76.2



Boilers have an efficiency of 77.3 per cent when operated at 60,000 lb of steam per hr, 150 psi pressure and 420F



Pulverizer can handle 8-in. coal in an emergency to supply the 1½-in. size necessary for the traveling grates

Ash drops off the grate into this hopper and is conveyed to the outside ash silo with steam jet once during each shift

Indiana coal, of 1½ in. screenings, is delivered to the plant by bottom dump railroad cars. It is dumped over a track onto a bar flight conveyer and lifted by elevator to a coal storage silo where it falls by gravity to feed an overhead bulk conveyer. The coal is conveyed the length of the firing aisle to each furnace hopper. As an emergency measure, a coal pulverizer has been installed in the basement of the powerhouse directly opposite the track hopper. This pulverizer can take up to 8-in. coal and reduce it to the proper size for stoker operation.

Coal from the hopper is picked up by the stoker traveling grate and fed to the furnace automatically. The rate of the grate travel is controlled by a fuel-flow air-flow ratio. The automatic dampers on the forced draft fans are controlled in conjunction with the fuel flow. For this reason, there has been little difficulty in regard to meeting the local smoke ordinances. Both the automatic damper control on the forced draft and stoker differential drive are actuated pneumatically

Water Treatment

Make-up water is taken from the city line and has a hardness of 14 grain as calcium carbonate. A hot soda and lime process of softening removes most of the hardness. In addition to this basic softening process, hot phosphates are discharged into the boiler drums.

Soda and lime are dumped into a slurry mixing vat by hand. The proportions are fairly constant as the city water hardness does not vary to any great extent. The feedwater is tested during each shift and the slurry concentration corrected if necessary. Chemicals for the softening system are pumped in slurry form into the settling tank with two motor driven pumps. The make-up water, after mixing with the chemical in the main settling tank, is discharged through three filters. These filters are backwashed once each shift and the backwash water returned to the settling tank.

Blow-down is continuous and is drained into a flash tank, where the flash steam is discharged to the deaerator, and the condensate flows to the sewer through a heat exchanger, which heats the make-up water before it enters the settling tank. The deaerator discharges to the boiler headers through 2-two stage 300 gpm 230 psi centrifugal pumps. These units are driven with non-condensing steam turbines that operate 3580 rpm with 130 psig line steam.

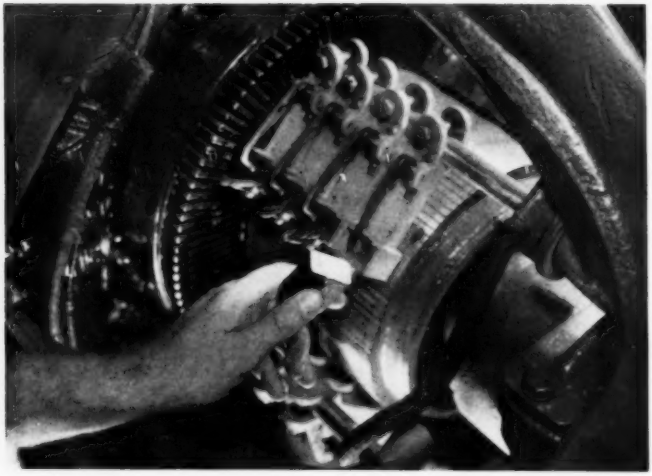
Exhaust from the steam turbines that drive the forced draft fan and feedwater pumps is discharged to the deaerator. If additional steam should be required for proper deaeration, it is bled from the steam main. Air and oxygen are vented directly to the atmosphere. Present analyses of make-up water show entrained air and oxygen are at the minimum.

Boiler Operation

At the present only two boilers are in operation at a time. One is base loaded to 60 per cent of loaded capacity while the other floats to meet demands throughout the plant. On a drop in pressure, the fuel-flow air-flow ratio control increases the speed of the stoker, and at the same time opens the dampers of the forced draft fans. This automatically increases the rate of combustion and a greater quantity of steam is generated. The third boiler is idle but can be placed into operation at a moment's notice. As the operating load in the plant drops off rapidly at the end of the shift, placing two boilers on line at reduced capacity permits ease of cut-back during slack periods. Conversely, with two units on line at the same time, sudden peaks can be met almost immediately.

PRINCIPAL EQUIPMENT FOR STEAM PLANT AT LA PORTE, IND.

Boiler	Riley Stoker Corp.	Chemical pumps and motors	Allis-Chalmers Mfg. Co.
Stoker	Riley Stoker Corp.	Feedwater pumps	Allis-Chalmers Mfg. Co.
FD fan	Clarage Fan Co.	Feedwater pump turbine	Terry Steam Turbine Co.
FD fan turbine	Terry Steam Turbine Co.	Air compressors and motors	Allis-Chalmers Mfg. Co.
FD fan vane control	Clarage Fan Co.	Automatic stoker drive	Reaves Pulley Co.
Fly ash	United Conveyor Corp.	Valves and fittings	Crane Co.
Soot blower	Diamond Power Specialty Co.	Pressure controls	Fisher Governor Co.
Coal handling	Link-Belt Co.	Emergency pulverizer	American Pulverizer & Crusher Co.
Combustion controls	Republic Flow Meters Co.	Emergency pulverizer motor	Allis-Chalmers Mfg. Co.
Feedwater treatment	Allis-Chalmers Mfg. Co.	Deaerators	Allis-Chalmers Mfg. Co.



When d-c motors fail to operate properly, here are some of the checks that can be made to find the trouble quickly. For minor faults, adjustments and repairs that may help keep the motor in service are also included

THOMAS TRAIL

Fig. 1—Commutator and brushes account for a large percentage of the maintenance problems on d-c machines

TROUBLE TIPS ON D-C MOTORS

DIRECT CURRENT motors are used extensively in industrial plants for applications where a-c motors are unsuitable, as on variable speed drives. Many of the maintenance problems are similar, but certain features require different treatment.

They should receive the same periodic maintenance, including cleaning, lubrication and examination suggested for a-c motors. In addition, however, special care should be given the commutator and brushes of d-c machines as these are the most critical parts of the motor.

When the motor fails to start, check starter or controller, overload devices, overspeed switches, line fuses, control circuit fuses, governors, temperature cutout relays, control interlock contacts, pilot switches and line voltage.

Where controller contacts do not close, check fuses and then determine if the operating coil is receiving full voltage. If so, it is evident that the coil is open and should be replaced, providing examination of the mechanical linkage of the controller has disclosed no sluggishness of operation.

Control Circuit

Should a full voltage indication not be obtained at the operating coil terminals, an open control circuit is indicated, and the various switches, followed by the wiring, should be examined in the control circuit.

In event the controller contacts close but the motor still fails to start, test the controller output terminals for voltage. Failure to receive a steady, full indication generally means that contacts need redressing or renewal, the contact shunts require replacement, or a resistor is open and in need of repair or replacement.

Where no fault can be found in the controller, make sure motor brushes are free in the holders or have not worn to the point where they no longer make contact with the commutator surface. Sometimes a broken brush shunt or brush holder pressure spring may be the cause of circuit interruption.

If none of these troubles are present, examine the motor for overload, frozen bearing or excessive friction in the rotating parts, particularly if controller starting contacts are severely when the circuit is broken.

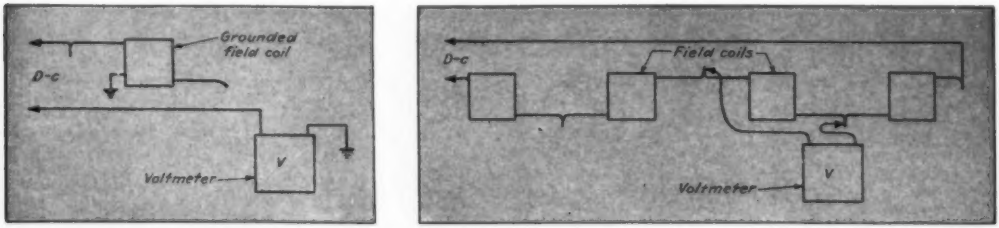


Fig. 2—Use low-voltage, high-current for testing series field coils, higher voltage for shunt field. Voltmeter range depends on source. Grounded coil, left, gives reading. Readings, right, are low for shorted, high for open coils

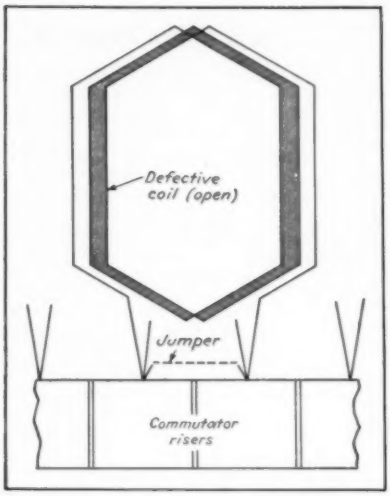


Fig. 3—Emergency repairs may sometimes be made on open armature coils by soldering jumper to leads at commutator. Shorted coils should be cut to prevent circulating currents

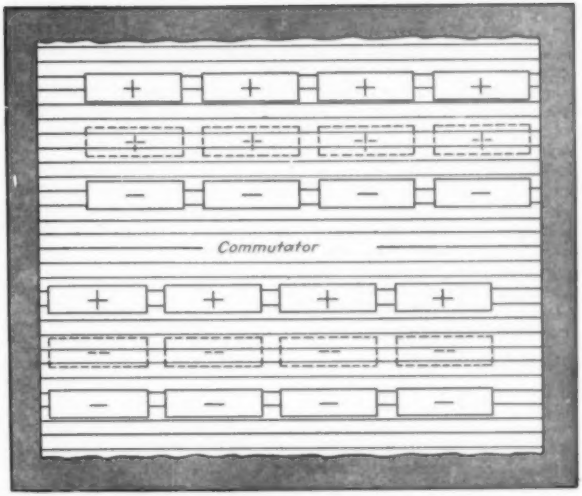


Fig. 4—Proper brush stagger prevents commutator grooving. Brushes are shown with solid outlines for four-pole layout. Six-pole arrangement includes brushes with dotted outlines

Failure to locate the trouble source thus far will require testing the motor terminals to determine if they are energized. This may be done by penetrating the wire insulation with sharp-pointed test prods. Tape the punctured insulation afterwards.

Burned Commutator

If voltage is present at the motor leads and none of the trouble sources mentioned has been found, examine the commutator for a burned spot along a mica separator and the adjacent bars. This indicates that the armature circuit has been interrupted whenever this spot passed under the brushes, due to an open armature coil or a defective connection between an armature coil lead and the commutator bar riser to which is is soldered. The motor may have stopped with the open circuit under one of the brushes, and, as a check, usually can be started if the armature can be manually rotated past this position with power circuit open.

Emergency Repairs

Defective coil lead connections should be carefully cleaned and resoldered. Where the trouble is due to an open armature coil, and the motor must temporarily be kept in service, an emergency repair may be made by connecting the two burned commutator bars with a wire jumper of sufficient size to carry the current, Fig. 3. The coil should then be replaced with a new one when the motor can be taken out of service for permanent repairs.

If the motor starts, then stops, check for power failure due to tripped overload device or blown fuse, which may be caused by defective controller contacts as well as overload.

Should the motor attempt to start but the overload relay opens, look for overload, or weak or open field. On an adjustable speed motor, the shunt field rheostat may be set too high, or it may have an open winding. If the fault is not found to be caused by overload or rheostat trouble, test the motor field, as shown in Fig. 2. An open circuit in the controller circuits for the field may also be the cause.

Field Connections

An open or weak shunt field circuit on a motor running light will usually result in increased motor speed, or in sparking at the brushes if the motor is heavily loaded.

A recently overhauled motor which, after being started, stops and reverses direction of rotation may have one field reversed, resulting in bucking of the shunt and series fields. Disconnect one field and energize the motor just long enough to determine direction of rotation. Repeat with only the other field connected. Then reconnect both fields to provide the same rotation in the proper direction.

The same procedure should be followed if the motor, when started after overhaul, has the wrong rotation.

Slow motor speed under load indicates possible low voltage (voltage should be within 10 per cent of the motor name plate voltage), overload, defective controller or contacts, motor too cold, or brushes set off neutral position. For the latter condition, which may also cause excessive brush sparking, see if neutral setting has been factory marked or dowelled and, if necessary, reset the brushes. If neutral position is unmarked, however, open the circuit to the motor, loosen

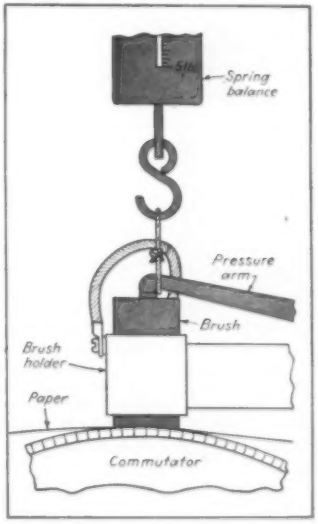


Fig. 5—Read spring tension when brush pressure can be barely felt on paper

brush rigging or end bell slightly (according to motor type), shift the brush position a small fraction of an inch in either direction, re-tighten brush rigging and start motor. Repeat this procedure until the brush position where least sparking occurs is found. Mark this position clearly. However, neutral position may shift under load, especially if the motor is not provided with commutating poles.

Slow motor speed may also be due to a short circuit in the armature winding or between commutator bars. To locate such a fault, look for burned armature coils or wedges, or blackened and burned commutator bars.

Short-Circuited Coil

If only one armature coil is short-circuited, a temporary repair may keep the motor in service until a new coil can be installed. Replace coil leads with a jumper connecting the commutator bars as in Fig. 3, and cut the coil to avoid circulating currents. Tape all cut ends.

Where a short circuit is found between commutator bars, cut away a thin top layer of the mica insulation to remove burned mica or embedded metallic dust.

Excessive motor speed may result from high voltage, underload (especially on series motors), weak field (due to rheostat, or open, shorted or grounded shunt field winding, Fig. 2), or, if the motor has recently been repaired, a reversed shunt or series field. Sometimes restriction of proper motor ventilation will cause the shunt field to overheat and increase in resistance, thus reducing the flow of current and weakening the field. Brushes off neutral position, indicated by sparking, can also be responsible.

Overheating

Previously mentioned troubles which also cause overheating of the motor are overload, high voltage, brushes off neutral and shorted, grounded or weak field or armature circuits. Other causes are insufficient ventilation, armature poling due to worn bearings, excessive brush pressure, wrong grade of brushes, defective bearing and excessive end thrust or belt tension. Some of these symptoms can cause either the armature, the commutator or the fields to become hot. While the part affected may be hotter than the other parts of the motor, heat produced will spread to other parts.

Sometimes machine work performed on an armature may destroy the insulation between punchings and thus produce heat due to circulating currents. In this case, the armature will become hot and the motor will draw a high current even when running light.

Sparking at the brushes may be caused by high mica, short brush, brush sticking in holder, insufficient brush pressure, brush shunt loose, wrong grade of brushes in use, rough or eccentric commutator, high, low or loose commutator bar, short-circuited commutating field coil and excessive vibration. Other causes previously mentioned are defective connections between armature coils and commutator bars, open circuit in armature, short-circuited armature coils or commutator bars or brushes off neutral.

Best check for possible short-circuited commutating coils is to measure their resistance. A coil having appreciably lower resistance than the others is short-circuited and should be repaired or replaced. However, the short frequently occurs only when the motor is running under load and the magnetic effect of the current compresses the coil. If present, this effect sometimes may be observed if the motor is momentarily energized, as in starting.

Brush Troubles

Where grooving of the commutator occurs it is usually due to improperly staggered brushes. Fig. 4 illustrates how motor or generator brushes should be staggered.

Excessive brush wear may be caused by a rough commutator, wrong grade of brushes, excessive brush pressure, abrasive atmosphere, chemical fumes, uneven or loose commutator bar, defective commutation or off neutral brush setting.

Brush chatter may result from loose fit in holders, wrong grade of brushes, high mica, dirty or rusty film on commutator, wrong brush angle or incorrect brush spring pressure, Fig. 5.

Motor vibration can be due to loose mounting, inadequate foundation, loose or unbalanced coupling or other rotating part, misalignment, poor gear fit, bent shaft, belt or chain whip, or the armature being out of balance.

Noise in a motor may be caused by loose mounting, armature rubbing the pole faces (poling), belt slipping or slapping or pounding, vibration, noisy bearings (particularly anti-friction bearings), or humming of armature teeth as they pass the pole pieces.

Symptoms of defective motor operation should always be promptly investigated and the faults corrected. Faulty motor operation, if permitted to continue, will generally grow worse until a major defect develops and causes a major service interruption while the motor is being repaired or replaced. Also, one fault may lead to another. Overheating, for example, could cause loose connections or commutator bars, unbalance or failure in the bearings.

River Raisin Paper Co.

● Our cover this month shows the mechanical clarifier installed in the River Raisin Paper Co plant at Monroe, Mich. for reclaiming stock from paper-mill white water. Designed for 2,100 gpm, the unit handles 2,000 gpm to take care of two seven-cylinder machines making about 200 tons of linear paper board per day.

Composite samples of white water taken over an eight-hour day show that the suspended solids of the water undergoing treatment averaged about 540 ppm (4.5 lb per thousand gal), the color was above 250 and the five-day BOD demand 128 ppm.

Effluent shows suspended solids of 31 ppm (0.25 lb per thousand gal), color of 28 and five-day B O D demand of 62 ppm. Sump discharge has a suspended-solids content of 10,570 ppm, containing paper fibers recovered for process.

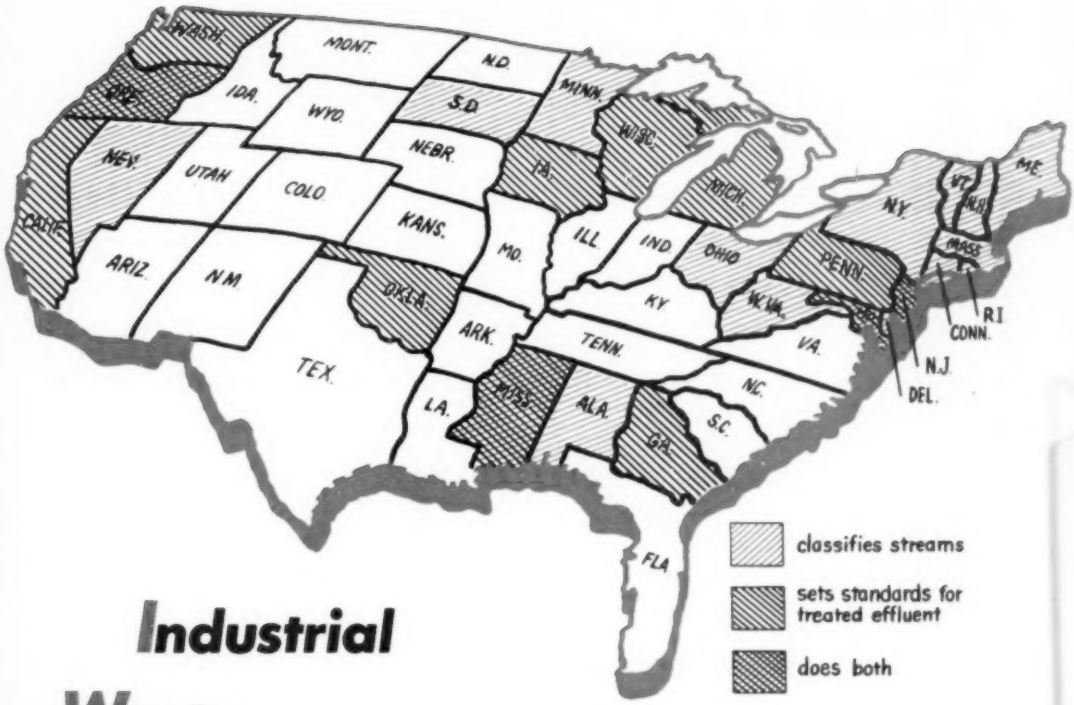
Chemical dosages vary considerably from a minimum of about two grains of alum when paper is sized, to about 11 grains per gal when no size is used. In addition, 10 ppm of activated silica is fed continuously to the primary circulating zone.

Complete installation costs of about $60,000 included piping, housing, booster pumps, clarifier, chemical buildings and feeders. Booster pumps were needed because waste water had to be lifted 50 ft. Total horsepower required for all operations is 65, which includes 5 hp for driving the clarifier, chemical feeders and auxiliaries.

The unit recovers 4.25 lb of stock per 1,000 gal of water treated, which, at the time of installation, had a value of $20 per ton. This gives a recovery value of $122 against total daily operating costs of $109.

Copies of Special Report

● Additional copies of the special report INDUSTRIAL WASTE TREATMENT are available for interested parties. Quantities up to five copies will be sent free; prices quoted for larger quantities.



Industrial Waste Treatment

By Gene Feller, managing editor
and
Janice Newman, editorial assistant

Let's be practical about ***stream pollution***—it did not happen over night. It came about gradually as a natural result of the nation's growth and industrial expansion. Farsighted engineers have been studying the problem for years and working on ways and means to eliminate pollution. To show what they have accomplished, INDUSTRY AND POWER gives the present status of state laws and follows through by describing typical treating methods.

Familiarity with the information in this report will put industrialists and legislators in a position to guide future pollution-abatement laws and assure competitors, regardless of location, that they face essentially the same restrictions.

Here is how a pollution program will affect engineers in all fields of industry:

1. They must look at pollution abatement from the viewpoint of those downstream who want to use the water for recreation including fishing, industrial purposes or domestic supply.

2. Waste treatment must be considered an integral part of production costs and invested capital, because it is a liability public opinion will eventually force industry to shoulder.

3. Treating facilities to fill all needs will require the expenditure of vast sums of money. Estimates show it may run as high as ten or twelve billion dollars for the equipment, and another quarter billion for yearly operating, maintenance and financial costs.

The end result will be business for manufacturers, work for consulting engineers and another problem plant engineers must solve the most economical way. Data on the following pages will serve as a guide for initial planning.

Special INDUSTRY AND POWER Report

1 - Legislative and administrative positions on control of water pollution

State	Require primary treatment of all waste	Law covers individual industry specifically	Controls established sources of pollution	New treating plant approval required	Advise or help design plant	Penalties provided	Streams now, or in process of, classification	Law provides for classification of streams	Each case considered on its own merit	State sets standards for treated effluent	Exemptions	Regulations to meet irrigation demands	Study being made for legislative action	Law also protects sea water
ALABAMA	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No	No
ARIZONA	No	No		Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	No
ARKANSAS	No (1)	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No
CALIFORNIA	No (2)	No	Yes	No (3)	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes
COLORADO	No	No	Yes	No	No	Yes	No	No	Yes	No	Yes (4)	No	Yes	No
CONNECTICUT	No	Yes (5)	Yes	Yes	Yes	Yes	Yes	No (6)	Yes	No	No	No	No	Yes
DELAWARE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes
FLORIDA	No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No	Yes
GEORGIA (7)	Yes (8)	No		Yes	Yes		No (9)	No	Yes	Yes	No	No	Yes	Yes
IDAHO (10)	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No
ILLINOIS	No	No	Yes	Yes	No	Yes	No	No	Yes	No	Yes (11)	No	No	No
INDIANA	No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No	No
IOWA	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes (12)	No	No	No
KANSAS	No	Yes (13)	Yes (14)	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	No
KENTUCKY	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No	No	No
LOUISIANA	No	No	Yes	No	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes
MAINE	No	No	No	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes
MARYLAND	Yes	Yes (15)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
MASSACHUSETTS	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes
MICHIGAN	No	No	Yes	Yes	Yes (16)	Yes	No	Yes	Yes	Yes	No	No	No	No
MINNESOTA	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
MISSISSIPPI	Yes	Yes (13)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes (44)	No	No	No
MISSOURI	No	Yes (17)	Yes (18)	Yes	Yes	Yes	No	No	Yes	No	No	No	No	No
MONTANA	No	Yes (19)	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No	No
NEBRASKA	No	No	No (20)	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes	No
NEVADA	No	No	Yes	No (21)	Yes	Yes	Yes	Yes (22)	Yes	No	No	No	No	No
NEW HAMPSHIRE	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	Yes
NEW JERSEY	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes (23)	Yes	No	No	No	Yes
NEW MEXICO	No	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	No	No	No
NEW YORK	No (24)	No	Yes (25)	Yes	No (26)	Yes	Yes	Yes	Yes (27)	No (28)	No (29)	No	No	Yes
NORTH CAROLINA	No	No	No	Yes (30)	Yes (30)	Yes (30)	No	No	Yes (30)	No	No	No	Yes	No
NORTH DAKOTA	No	Yes (31)	No	Yes	No	No	No	No	Yes	No	No	No	Yes	No
OHIO	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes (32)	No	No	No
OKLAHOMA	Yes	Yes (33)	Yes	Yes	No	Yes	No (34)	No	Yes	Yes	No	No	Yes	No
OREGON	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
PENNSYLVANIA	Yes	Yes (15)	Yes	Yes	No	Yes	No (45)	No	Yes (46)	Yes	No	No	No	No
RHODE ISLAND	No	Yes	Yes	Yes	Yes	Yes	Yes	No (35)	Yes		No	No	No	Yes
SOUTH CAROLINA	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No	Yes
SOUTH DAKOTA	No	No	No	Yes	No (47)	No	Yes	Yes	Yes	No	No	No	No	No
TENNESSEE	No (36)	No	Yes	Yes	Yes (37)	Yes	No	Yes	Yes	No	No	No	Yes	No
TEXAS	Yes	No	Yes	Yes	Yes (38)	Yes	No (39)	No	Yes	No (40)	Yes (41)	No	No	Yes
UTAH	No	No	No	No	No	No	No	No	Yes	No	No	No	Yes	No
VERMONT	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	No
VIRGINIA	No	No	Yes	Yes	No	Yes	No	Yes	Yes	No	No	No	No	Yes
WASHINGTON	No	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No	No	No	Yes
WEST VIRGINIA	No	No	Yes	Yes	No	Yes	Yes (42)	No	Yes	No	Yes (43)	No	No	No
WISCONSIN	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No
WYOMING	No	No	Yes	Yes	No	Yes	No	No	Yes	No	No	No	Yes	No

How various states measure and regulate stream pollution

Numbers in the margin refer to corresponding numbers on Table 2, which appears on the following pages.

Alabama is currently reviewing data prior to adopting criteria and standards for classifying streams.

Arizona has set no standards, but in many areas, standards for irrigation water determine mining waste treatment.

Arkansas requires that before waste can be discharged into surface waters, treatment must be provided so that waste will not deplete the oxygen supply, nor cause the receiving water to be too acid or alkaline to support fish life. Other chemical constituents would not be tolerated in amounts injurious to fish life nor objectionable in water sources.

(1) California standards shown are those set by the State Water Pollution Board as criteria used for deciding cases appealed from regional water board decisions. The regional boards have authority to set standards of their own. Figures given in the table are maximum, not optimum desired by board. Space did not permit printing complete criteria set up by state board.

Connecticut has not adopted standards but belongs to the New England Water Pollution Control Commission and uses the commission's standards.

Delaware's stream standards are to be based on findings of stream and industry survey. Each of the water areas will be analyzed and classified separately with consideration given to economic usages.

Georgia, with no specific water-pollution law, has an extensive and long-established program preserving the state's streams for the highest usages.

Illinois treats each problem separately, considering stream condition and usage as well as type of effluent in deciding each case.

(2) Indiana uses standards to determine dividing line between polluting and non-polluting conditions.

Kansas' main industrial-waste problem is in the oil fields, and for these the state has a complete set of special regulations.

Kentucky has just begun a stream-pollution control program and may set standards in the next few months.

Louisiana, like Kansas, has complete regulations only for oil-field wastes.

(3) Maine has used the New England Water Pollution Control Commission's standards as a basis for classifying streams, adding some supplementary standards.

(4) Maryland water-criteria standards shown are the limits for any one day. Standards are also set for monthly average figures, which are slightly higher.

(5) Regulation IV, December 1949, sets standards for treatment and disposal of industrial wastes, which any industrial waste must meet before being emptied into any state water.

Massachusetts has used the New England Water Pollution Control Commission's standards as a basis for classifying streams.

Minnesota asks either primary or complete treatment of all wastes. Since most streams are small, complete treatment is usually asked. That is considered to be such that the effluent will contain not more than 20 ppm biochemical oxygen demand or suspended solids.

Missouri has not established minimum chemical standards but considers each problem separately.

Montana controls discharges into streams used as a water supply. In such streams all discharges must be purified.

Nebraska prohibits dumping or draining any refuse into or near any waters of the state.

(6) New Jersey river standards are set according to water uses and population concentration. Beginning zone numbers up the rivers where population and industry are less concentrated and water may be used for public supplies, the higher zone number indicates a generally lower water standard. Effluent standards for the Raritan river will be raised even higher on completion of a drainage canal paralleling the valley with a general treatment plant near the mouth of the river.

New Mexico has no stream standards. Evaluation of specific conditions is based on the creation of a health hazard or nuisance. In general, a minimum dissolved oxygen content of 4.0 ppm is required to maintain fish life. Removal of floating solids and scum is also required.

CONTINUED ON PAGE 18

FOOTNOTES TO TABLE 1

1 Recommend at least primary treatment of all wastes where new plants are to be installed, but if sufficient dilution is afforded treatment is deferred in some cases.
2 Case by case study of individual pollution problems.
3 Approval of new plant plans and specifications is not required. Pollution control boards can only prescribe requirements for effluent discharged and/or conditions to be maintained in receiving waters or disposal area.
4 Denver water supply is covered by special law giving the city authority to protect the area. While the question has not been tested in courts, it appears that this provision does not exclude state jurisdiction over pollution of these waters.
5 Oil refineries.
6 Interstate compacts provide for classification.
7 No specific water pollution statute, but Georgia has an extensive and long established program of water-pollution control carried on by the Water Pollution Control Division of the Department of Public Health.
8 In most cases.
9 All streams are preserved for the highest uses.
10 Idaho has no statute on pollution but is considering one.
11 Sanitary district of Chicago is exempted from state regulations.
12 Border streams are exempted from procedures whereby orders may be issued requiring treatment, but not from requirements for permits.
13 Oil-field wastes.
14 Law exempts sewer systems operating prior to 1907, but since most industries and practically all cities have extended systems since then, law can be said to apply to all.
15 Mine acid drainage.
16 Advises, but does not help design plant.
17 "Few scattered laws, seldom used."
18 No pollution law as such, control is exercised through health and conservation regulations.
19 Coal slack.
20 Before 1931.
21 New treating-plant approval is required if the formation of a sanitary district is involved.
22 Implied power.
23 Within statute.
24 Standards adopted by the board for most classes of water will require primary treatment as a minimum.
25 Authority becomes effective only after specific waters have been officially classified and assigned standards of quality.
26 Consultation in advance of design is encouraged.
27 So far as compliance with stream standards is concerned.
28 Stream standards will determine degree of treatment.
29 Law makes provision for extension of time on orders requiring abatement of pollution where violator can prove his financial inability or that no reasonable method of treatment is known.
30 Where public water supply is involved.
31 Gas tar.
32 Acid and silt drainage from mines.
33 Oil wells.
34 Present studies will provide data that can be used to set up classification if favorable legislation is passed.
35 Interstate compacts classify interstate streams.
36 Does not apply to wastes, which carry no floating or settleable solids.
37 Health board works closely with industrial officials or engineers, but actually does not participate in the design except in an advisory capacity.
38 Department advises with consulting engineers and assists cities in planning new, or improvements to, treatment plants.
39 According to court interpretation, all streams are classified as "Grade A", but there is no classification program.
40 There is no definite set of standards, however, the fact that the law requires that waste water will not affect the quality of the receiving water implies that certain quality standards must be met.
41 Law does not apply to effluents, which contain no organic matter that will putrify, or any poisonous compounds, or any bacteria dangerous to public health or destructive of the fish life of streams or other public bodies of water.
42 System might more appropriately be called "stream zoning" since streams are zoned according to the water quality.
43 Coal mining industry is exempted.
44 Mississippi River.
45 Sanitary Water Board is placing streams in categories within which minimum specified degrees of industrial-waste and sewage treatment are required.
46 Minimum treatment required for all cases depending on stream category, but additional treatment may be necessary.
47 Occasionally assistance is offered consulting engineers regarding certain features of design.

2 - Standards used to determine the purity of

State	Water classification	Minimum dissolved oxygen	Maximum biochemical oxygen demand	pH	Maximum fluorides	Maximum chlorides	Maximum phenolic compounds
CALIF. (1)	Domestic Supply	2 ppm	0.5 ppm	6.6—8.0	1.5 ppm	750 ppm	5 ppb
	Bathing & Swimming	2 ppm	10.0 ppm	6.5—8.6			50 ppb
	Wildlife Propagation	3 ppm	30.0 ppm	6.5—8.5		2500 ppm	1 ppm
	Irrigation			6.0—9.0	5.0 ppm	750 ppm	20 ppb
	Food Processing	1 ppm	5.0 ppm	6.0—9.0		1000 ppm	10 ppb
IND. (2)	Minimum Standards for Clean Water	50% Sat.			Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts
KAN.		5 ppm		6.5—8.5			
MAINE (3)	Public Water Supply	75% Sat. 7 ppm	0—2.0	6.0—8.0			
	Recreation, Irrigation & Fish Habitat	75% Sat. 7 ppm	2.0—3.0	6.0—8.0			
	Boating, Some Irrigation, Wildlife	60% Sat. 5 ppm	3.0—4.0	5.5—8.5			
	Transportation of Sewage, Navigation	35% Sat. 3 ppm	3.0—4.0	5.5—8.5			
	Lowest class	35% Sat 3 ppm	Over 4.0	5.0—9.0			
MD. (4)	Excellent Water S'ply	6.5 ppm	0.75 ppm	6.2—8.4	1.0 ppm	50 ppm	None
	Good Water S'ply, Fish Habitat and Recreation	5.0 ppm	2.5 ppm	5.8—9.0	1.0 ppm	250 ppm	5.0 ppb
	Poor Fish Hab't or Recreation, Treated Supply	3.0 ppm	6.0 ppm	3.8—5.8 or 9.0—10.5	1.0 ppm	500 ppm	25.0 ppb
	Unsatisfactory Water	Less	Over	Less or more	Over 1.0	Over 500	Over 25
(5)	Industrial Wastes must meet these requirements except acid mine drainage		100 ppm	5.5—8.5	Dissolved solids must not exceed 1500 ppm with exception of natural mineral salts		
MICH.	Conditions constituting unreasonable pollution	Below 50% Sat.		Beyond 5.8 to 9.6		Impairs quality	
MISS.	Min. Water Standards 1000 ft from outfall	4.5 ppm		6.5—8.4		1,000 ppm (NaCl)	
N. H.	Water Supply (Needs disinfection only)	No discharge of wastes of any kind					
	Water Supply, Bathing and Recreation	75% Sat.	Treated wastes must not lower characteristics				
	Treated Water Supply, Boating, Fish Habitat & Industry S'ply	75% Sat.	Treated wastes must not lower characteristics				
	Boating, Industry S'ply with treatment	5 ppm		5.0—8.5	Free of any chemicals inimical to fish life		
	Transportation of Sewage or Wastes	Some					
N. J. (6)	Effluent Standards For Raritan River						
	Zone I		70 ppm	No free acidity or caustic alkalinity, toxic or deleterious substances			
	Zone II		100 ppm	No free acidity or caustic alkalinity, toxic or deleterious substances			
	For Delaware River						
	Zone I	Not reduced more than 5%	50 ppm	Sufficiently free not to menace health, wildlife or other water uses			
	Zone II	Not reduced more than 10%	100 ppm	Sufficiently free not to menace health, wildlife or other water uses			
	Zone III	Restore 50% sat.	Reduction of 35% min.	Sufficiently free not to menace health, wildlife or other water uses			
	Zone IV						
N. Y.	Excellent Water S'ply	4 ppm (7)		6.5—8.5	(8)		
	Good Water Supply	4 ppm (7)		6.5—8.5	(8)		5.0 ppb
	Bathing	4 ppm (7)		6.5—8.5	(8)		
	Fishing	4 ppm (7)		6.5—8.5	(8)		
	Agriculture & Industry	3 ppm		6.0—9.5	(8)		
	Transportation	Sufficient		5.0 min			
	Waste Disposal	Sufficient					
N. D.	Standards for treated effluent into Red River		25 ppm				
OHIO (9)	Tentative Standards for Average Stream	4.0 ppm	5.0 ppm	6.3—9.0	1 ppm	250 ppm	30 ppb
OKLA. (11)	Present Effluent Standards	Not reduced below 3 ppm	25 ppm	Not changed			
ORE. (12)	Effluent Standards	5 ppm		6.5—8.5			
TENN. (13)		4 ppm		6.5—8.8			
W. VA.	Excellent Water S'ply	7.5 ppm	0.75 ppm	6.3—7.7	0.5 ppm	100 ppm	None
	Good Water S'ply, Fish Habitat, Recreat'n	6.0 ppm	2.5 ppm	5.8—9.0	1.0 ppm	250 ppm	5.0 ppb
	Poor Fish Habitat & Recreational Water	4.0 ppm	6.0 ppm	3.8—5.8 or 9.0—10.5	1.0 ppm	500 ppm	25.0 ppb
	Unsatisfactory Water	Less than 3.0	Over 6.0	Beyond 3.8 or 10.5	Over 1.0 ppm	Over 500 ppm	Over 25 ppb
WISC.	Minimum Standards used as a guide		Not less than 30% removal	Reduction of concentration of chemicals to not more than lethal limit			

water or plant effluent, or to classify streams

Maximum iron	Maximum color	Maximum turbidity	Maximum taste	Maximum odor	Suspended solids	Floating solids	Sludge deposits
	30 ppm	20 ppm	Noticeable	Noticeable	100 ppm	None	
	30 ppm	20 ppm	Marked	Noticeable	100 ppm	Gross	
	10 ppm	10 ppm	Marked	Marked	20 ppm	Gross	
	30 ppm	20 ppm	Marked	Obnoxious Marked			
Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts	Not in deleterious am'ts	None
Consider use and type of stream in determining standard							
	None	None		None	None	None	None
	Not obj'ble	Not obj'ble		None	Not obj'ble	None	None
	Not obj'ble	Not obj'ble		None	Not obj'ble	Not obj'ble	None
	Not obj'ble	Not obj'ble		Not obj'ble	Not obj'ble	Not obj'ble	Not obj'ble
	Obj'ble	Obj'ble		Obj'ble	Obj'ble	Obj'ble	Obj'ble
0.3 ppm	20 ppm	10 ppm	Slight	Slight	None	None	None
1.0 ppm	75 ppm	250 ppm	Slight	Slight	None	None	None
15.0 ppm	150 ppm		Slight	Slight	None	Localized	Localized
Over 15	Over 150		Present	Present	Present	Present	Mod. to heavy
				Threshold No. 1,000, Mixture in water No. 80		1/32 in. dia.	
	400 ppm	300 ppm				30 ppm oil	
	Unnatural or offensive	Unnatural or offensive		Offensive	To blanket stream bed	Oil—more than 15 ppm	
			Nothing to flavor fish			None noticeable	
				No obj'ble quantities	No obj'ble quantities	No obj'ble quantities	
				Free of unreasonable kind, quantity or duration, considering industry involved			
	Not notic'ble	Not notic'ble		Free		Free	
	Not notic'ble	Not notic'ble		Free		Free	
	Not notic'ble	Not notic'ble	Free	Free	Practically free	Free	
	Not notic'ble	Not notic'ble Sufficiently free	Free	Free	Practically free	Free	
		Sufficiently free	Practically free	Practically free	55% reduction	Free	
			Practically free	Practically free	55% reduction	Free	
			None	None	None	None	None
				Threshold No. 8	None visible or to increase	None visible or to increase	None visible or to increase
					None visible or to increase	None visible or to increase	None visible or to increase
					None visible or to increase	None visible or to increase	None visible or to increase
					None visible or to increase	None visible or to increase	None visible or to increase
				Not to be nuisance	Not to interfere	Not to interfere	Not to interfere
				Not to be nuisance	Not to be nuisance	Not to be nuisance	Not to be nuisance
					30 ppm		
5.0 ppm (10)	Non-offensive			Non-offensive		Substantially eliminate oil	None
	Not notic'ble	Not notic'ble				Not notic'ble	
	Not obj'ble	Not obj'ble				Not obj'ble	No appreciable formation
	None to interfere with uses	None to interfere with uses	None	None	None visible	None visible	No appreciable formation
0.3 ppm	20 ppm	10 ppm	Slight	Slight	None	None	None
0.3 ppm	100 ppm	250 ppm	Slight	Slight	None	None	None
			Slight	Slight	None	None	Slight local
			Present	Present			General
					Removal of not less than 45%	Substantially complete removal	

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New York has just begun stream classification with standards adopted October 25, 1950.

(7) Trout streams require 5.0 ppm dissolved oxygen

(8) Other standards: Based on non-trout streams of approximately median alkalinity (80 ppm) or above, in which group most industrial areas fall, and without considering increased or decreased toxicity from possible combinations, the followng may be considered safe stream concentrations:

Ammonia or ammonium compounds	Max. 2.0 ppm (NH_3) at pH 8.0
Ferro or ferricyanide	Max. 0.4 ppm ($Fe(CN)_6$)
Cyanide	Max. 0.1 ppm (CN)
Zinc	Max. 0.3 ppm (Zn)
Cadmium	Max. 0.3 ppm (Cd)

North Dakota has used a minimum standard for dissolved oxygen of 3 ppm but now finds 5 ppm is a better standard. Degree of other chemicals permitted depends on stream flow and size. Stream standards only for Red River.

(9) Ohio's water-quality standards will vary according to stream and use. Specifications in table will ultimately be considered for "second-best" waters suitable for sources of public water supply subject to purification.

(10) Other standards:

Cyanide (as CN)	Max. 0.15 ppm
Copper (as Cu)	Max. 0.4 ppm
Chromium (as hexavalent Cr.)	Max. 2.0 ppm
Zinc (as Zn)	Max. 15.0 ppm
Lead (as Pb)	Max. 0.35 ppm
Free acid	None
Sulfates	Max. 300.0 ppm

(11) Oklahoma will consider a new pollution law, "Report of the Sub-Committee on Stream Pollution", which will classify streams.

(12) Oregon law states that "No sewage or industrial waste shall be discharged into any waters, which in itself or in conjunction with other wastes will cause water to drop below standards." Streams are classified as follows:

Class A-Streams used for public water supply, bathing, etc., which, because of insufficient flow, cannot receive, without detriment, wastes other than those given a high degree of treatment. Effluent shall be free of noticeable floating solids, oil, grease, sleek, and practically free of suspended solids. BOD reduction shall not be less than 85% or residual BOD 50 ppm.

Class B-Streams which provide sufficient dillution to obviate the necessity for degree of treatment required under Class A. Effluent shall be free of noticeable floating solids, oil, grease, and oily sleek; average suspended solids reduced at least 55%; BOD reduction not less than 35% or residual BOD 125 ppm.

Class C-Streams wherein a temporary discharge of untreated sewage or waste may be permitted if it is not detrimental to any reasonable use of said waters. Temporary permit valid for three years and may be revoked.

Pennsylvania has four stream classifications: (1) those wherein wastes require only primary treatment; (2) those demanding intermediate treatment; (3) clean streams where complete treatment will preserve quality of water; and (4) streams already so badly contaminated that untreated wastes will not hurt them.

Under the "Clean Streams Program", the Sanitary Water Board issued rules and regulations relating to wastes of individual industries, treating each industrial waste as a separate problem.

Rhode Island uses the New England Water Pollution Control Commission's standards to classify streams.

South Carolina plans to set standards for receiving waters, program begun in August 1950.

(13) Tennessee sets minimum criteria which wastes must not lower. Other standards: Increase of hardness or addition of soluble mineral compounds shall not appreciably impair value of water; no substance in waste to produce toxic conditions; and any other pollutants shall not be in detrimental quantities.

Texas courts have interpreted existing laws to imply that any effluent discharged into state waters shall not materially affect quality of water.

Utah is presently working on a law for the 1951 legislature, which will protect irrigation waters coming from small streams where dillution is not possible. Here wastes will require complete treatment.

Vermont uses the New England Water Pollution Control Commission's standards to classify streams.

Virginia issues a certificate to each owner discharging sewage into state waters and asks for a report every three months on progress in developing and carrying out a program for reduction of pollution.

Washington has minimum requirements for **prevention** of waste.

Wyoming urges removal of all wastes up to the limit of economic feasibility regardless of dilution factor, under the assumption that future industrial establishments with equal rights might eventually degenerate streams.

Some facts about the State Laws not in the tables

THE tables contained in this report will provide ready reference to basic requirements in the various state's anti-pollution legislation. Flexibility of state laws permitted a certain amount of leeway in itemizing specific requisites under common column headings but, for best interpretation of the tables, study the footnotes and explanations carefully. For example: The fact that California and Colorado do not require approval of plans before construction of a waste disposal plant cannot be interpreted as a similarity of laws.

California has recently dropped this feature of its pollution program to free its board for the more important job of finding and correcting instances of pollution, while the Colorado Board has no authority to examine disposal systems, except when the Health Department finds a public health hazard is being created.

Only three states—Idaho, North Carolina and Utah—have no law or program for regulating stream pollution. These states, however, now have studies in progress to produce legislation for such protection. Oklahoma, with an obsolete law, has completed a study which it hopes will be adopted by the next legislature to bring the legal framework up to date with the problem and the Health Department's thinking on the question.

Other states without definite stream-pollution legislation have been able to take action within the framework of existing laws—legal protection of public water sources, game and fish conservation laws, or riparian rights. In 1938, the voters of Oregon used the initiative method to pass a law making the preservation of clean water a state policy.

Of the 42 states requiring approval of new treating-plant plans before construction, four states exercise control over the entire industrial layout, while nearly as many others require nothing more than board permission to discharge wastes into a stream. Five states have a general prohibition of all pollution, but interpretation of the word "pollution" varies widely. Few states are as strict as Texas, where, by court interpretation, anything that changes or lowers the quality of the water from its natural condition is prohibited, thus preserving all waters as Grade *A*.

This problem of determining what constitutes pollution has been subject to almost as many interpretations as there are states making the interpretation. As the table on the preceding pages and the accompanying text show, what one state considers polluting, another state passes as satisfactory.

A few states have adopted regulations applying certain standards and treating methods to all effluents of a single industry. Pennsylvania's Sanitary Water Board has, in addition to stream classifications, regulations for such industries as pulp and paper mills, milk plants, oil and natural-gas wells, other wells, pickling-acid wastes from metallurgical plants, and others. The Washington State Pollution Control Commission has recommended treatment and reclaiming of wastes in an effort to *prevent* rather than correct pollution. It is too early to judge success of this experiment.

In five states, the pollution law includes a provision for charging or taxing industry for the preservation of clean water. Kansas makes a tax assessment against oil producers at the rate of 1/25th cent per barrel sold for enforcement of the law. Virginia charges a minimum license fee of one dollar for processing and approving plant plans; the license fee in Maine is $50 for each new source of pollution. Several

other states permit municipal sewage plants to treat local industrial wastes and charge the industry accordingly.

A few of the state water control boards exercise authority over the digging of water wells, however, in most states this is a separate authority of the health department. Pollution control is exercised by direct definition over all waters of the state, river, stream, lake, or underground source, as well as sea water along the coastal states.

According to a recent decision of the U. S. Supreme Court, West Virginia is permitted to continue its membership in the Ohio River Valley Water Sanitation Commission. The controversy was first stirred up about two years ago, when the state auditor refused to authorize payments toward the commission's expenses on the grounds that the legislature did not have authority to commit the state to the pact. The final decision clears up this controversial point.

The Federal Government enters the picture

Since June, 1948, the federal government has been in the water-pollution control picture. Public Law 845, passed by the 80th Congress, is an act "to provide for water-pollution-control activities in the public health service of the Federal Security Agency and in the Federal Works Agency."

This law emphasizes the primary responsibility of the state governments in the regulation of stream pollution, but it also recognizes the interstate scope of many pollution problems and the need for financial and technical aid in many parts of the country.

Basically, the law contains provisions for: (1) the development of comprehensive programs to prevent or abate pollution, (2) research in the whole field of water-pollution control, (3) construction of sewage and industrial-treatment plants, (4) financial and technical aid to states, interstate agencies, and municipalities, and technical aid to industry and (5) abatement of pollution in interstate waters through legal processes where needed.

For purposes of administration and the development of comprehensive drainage-basin programs, the water-pollution control division has divided the nation into eleven major drainage-basin areas, and has established a chief basin engineer in each.

These drainage-basin offices (not to be confused with interstate organizations which, in many cases, cover the same areas) are engaged in preparing comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof. When completed, these plans may be used by the states as a basis for action, but the programs, as such, will not be enforceable upon any state.

The act provides for research in the whole field of water-pollution control, with special grants being made for study or research projects having sectional or national significance. The division is giving preference to projects in which industry cooperates by supplying funds or skills. This action is based on the board's stand that the solution of industrial-wastes problems is the responsibility of industry.

The Environmental Health Center in Cincinnati provides technical assistance to federal and state agencies and, through them, to manufacturers and industries by providing specialized personnel, and making available the results of other research and investigations.

The law also empowers the federal government to order the abatement of pollution in interstate waters when it creates a nuisance or health hazard in an adjoining state, and to support that order with legal action if the occasion arises. The state's authority in this field is carefully protected, and no action can be taken without the consent of the proper state authorities.

Officials who provided data

In collecting and tabulating the state laws on water pollution and waste disposal, the state health departments and the water control boards of the various states provided invaluable assistance. These officials personally checked our tabulations with their own official interpretation of the laws. The names listed below are not intended to supply a reference list for further information on the question, but, in most cases, these men or their assistants will be glad to answer pertinent questions on water-pollution problems arising in areas under their supervision.

Alabama: J. C. Clarke, asst. sanitary engr., Dept. of Public Health.
Arizona: G. W. Marx, dir. & chief engr., and C. E. Trygg, sanitary engr., Dept. of Health.
Arkansas: H. R. Conway, asst. dir., Water Pollution Control Comm.
California: V. W. Bacon, exec. officer, Water Pollution Board; and F. M. Stead, chief, Environmental Sanitation, Dept. of Public Health.
Colorado: W. N. Gahr, dir., Div. of Sanitation, Dept. of Public Health.
Connecticut: W. J. Scott, dir., Bureau of Sanitary Engrg., Dept. of Health.
Delaware: A. J. Kaplovsky, supr. engr., Water Pollution Comm.
Florida: D. B. Lee, dir., Bureau of Sanitary Engrg., Board of Health.
Georgia: W. H. Weir, dir., and G. R Frith, assoc. dir., Dept. of Public Health.
Idaho: H. C. Clare, dir., Environmental Sanitation, Dept. of Public Health.
Illinois: C. W. Klassen, tech. secy., Sanitary Water Board.
Indiana: B. A. Poole, tech. secy., Stream Pollution Control Board.
Iowa: P. J. Hauser, dir., Div. of Public Health Engrg., Dept. of Health.
Kansas: G. E. Mau, chief, Water Pollution Control Sec., Board of Health.
Kentucky: F. C. Dugan, tech. secy., Water Pollution Control Comm.
Louisiana: F. J. Coogan, tech. advisor, Stream Control Comm.; and J. H. O'Neill, dir., Div. of Public Health Engrg., Dept. of Health.
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Ohio River Valley Water Sanitation Comm: E. J. Cleary, exec. dir. & chief engr.
Interstate Comm. on Potomac River Basin: E. R. Cotton, dir.
Interstate Sanitation Comm: S. G. Hess, dir. & chief engr.
New England Interstate Water Pollution Control Comm: J. C. Knox, secy.
Public Health Service, Federal Security Agency: Leonard B. Dworsky.

3 - Water criteria or effluent standards used by interstate organizations

Interstate organization and method of measurement	Water classification	Minimum dissolved oxygen	Maximum biochemical oxygen demand	pH	General chemical requirements	Maximum color	Maximum turbidity	Maximum taste	Maximum odor	Suspended solids	Floating solids	Sludge deposits
Interstate Commission on the Delaware River Basin Minimum effluent standards in each Zone	Zone I	Not to reduce supply in river after dispersion more than 5% of saturation	50 ppm or reduction of organic substances at least 85%		Sufficiently free of acids, alkalies, toxic or deleterious substances not to create a health menace or be inimical to other uses of the water		Sufficiently free not to cause turbidity in river	Free	Free	Practically free	Free of oil, grease or sleek	
	Zone II	Not to reduce supply in river after dispersion more than 10% of saturation	100 ppm or reduction of organic substances at least 85%		Same as for Zone I		Same as Zone I	Free	Free	Practically free	Same as Zone I	
	Zone III	To restore river to at least 50% sat.	Reduction of not less than 35%		Same as for Zone I		Practically free	Practically free	Practically free	Substantially free	Same as Zone I	
	Zone IV						Not to cause substantial turbidity in river	Practically free	Practically free	Substantially free	Same as Zone I	
Interstate Commission on the Potomac River Basin Minimum water quality criteria for streams in basin	Class A	7.5 ppm monthly average		6.0 — 8.0	No toxic substances such as oils, tars, or free acids	10 ppm	10 ppm	No taste or odor producing substances			None	None
	Class B	6.5 ppm monthly average, single sample 5.0 ppm	5-day 1.5 ppm Single 3.0 ppm	6.0 — 85	Same as for Class A	20 ppm	40 ppm	Same as Class A	Same as Class A		None	None
	Class C	6.5 ppm monthly average, single sample 5.0 ppm	5-day 2.0 ppm Single 4.0 ppm	6.0 — 85	Same as for Class A	Permitted if removable with standard equipment	Permitted if removable with standard equipment	Same as Class A	Same as Class A		None	None
	Class D	4.0 ppm monthly average, daily average 3.0 ppm, single 2.0 ppm	5-day 3.0 ppm Single 5.0 ppm	6.0 — 85	Same as for Class A				No offensive odors at any time		None	Slight localized deposits if unpreventable
Interstate Sanitation Commission Sewage treatment standards	Class A	Vicinity of discharge — 50% sat. any week								Remove at least 60%	Remove all	
	Class B	Vicinity of discharge — 30% sat. any week								Remove at least 10%	Remove all	Avoid formation of beds
International Joint Commission	Standards for treatment of effluents		Removal of substances capable of reducing dissolved oxy. unreasonably	5.5 — 10.6	Reduce phenolic compounds not less than 90% or effluent maximum of 10 ppb phenol or phenolic equivalents. Iron maximum 17 ppm in terms of Fe. Toxic wastes eliminated or reduced to safe limits	Reduce unnatural amounts	Reduce unnatural amounts		Threshold odor max. 8		Oil max 15 ppm. Remove any which create fire hazard, coat hulls, injure wildlife or affect shore line use.	
New England Interstate Water Pollution Control Commission Standards for water classification	Class A	75% Saturation			No phenols or other taste producing substances, potentially toxic substances or free acids or alkalies	None	None	None	None		None	None
	Class B	75% Saturation			Same as Class A	Not objectionable	Not objectionable	None	None		None, no appreciable oil or grease	None
	Class C	5 ppm			No phenols or other taste producing substance nor free acids or alkalies. Potentially toxic substances in non-toxic concentrations	Not objectionable	Not objectionable	None	None		None, oil and grease not objectionable	None
	Class D	present			Acid and alkalies permitted if not in objectionable am'ts. Potentially toxic substances in non-toxic concentrations	Not objectionable	Not objectionable		Not objectionable		Not objectionable	Not objectionable

4 - Interstate agencies concerned with water pollution

Interstate organizations	Member states	Area	Purpose and functions	Power of enforcement	Set water standards	Stream zoning	Special features
Interstate Commission on the Delaware River Basin, "Incodel"	New Jersey, New York, Delaware and Pennsylvania	Approximately 13,000 sq mi	Formulating programs for wise control, utilization and development of basin. Acts in advisory capacity to state health departments.	None. All programs developed by commission are referred to state governments affected thereby for approval and adoption. Administration remains with established agencies of respective states.	No	Four zones following course of river.	Commission derives authority from laws reciprocally enacted by legislature of four states creating individual state "Commissions on Interstate Cooperation." Does not require ratification by Congress.
Interstate Commission on the Potomac River Basin	Pennsylvania, West Virginia, Maryland, Virginia and the District of Columbia	14,000 sq mi. All area drained by Potomac and its tributaries	Planning and execution of a coordinated plan of pollution control and abatement, looking to unified plan for use-development of natural resources.	No police power or legal action. Commission can make recommendations to states on any matter it deems sufficiently important to warrant attention.	Empowered to prepare and recommend standards but water criteria recommendations only have been made. See chart.	No	Commission carries on sampling program to determine water quality as it exists; is presently considering setting minimum specifications for effluents.
Interstate Sanitation Commission	New York, New Jersey and Connecticut	New York Harbor and adjacent tidal waters and estuaries. District is approximately 50 mi across.	Commission may advise municipalities, states or other entities to take steps to abate pollution. If they fail to do so, Commission may bring action in courts of state involved.	Commission may begin legal action in the event it finds an entity in the district failing or omitting, or about to fail or omit to do anything required by commission's order or the laws governing control of pollution.	Yes, see chart. Physical and bacteriological standards refer to effluent, chemical standards to water in vicinity of outflow.	Class A—primarily for recreation purposes, shellfish culture and fish life. Class B — Not for above purposes.	Article X of compact provides that any order need prescribe not only the reasonable date on or before which pollution shall be abated but also may prescribe certain specific progress at certain dates prior to final date.
Ohio River Valley Water Sanitation Commission	Indiana, West Virginia, Pennsylvania, New York, Illinois, Ohio, Kentucky and Virginia	154,880 sq mi, Ohio River, boundary streams or interstate streams	Control of future pollution and abatement of existing pollution	Issue orders on any . . . corporation, person, or other entity discharging waste, and prescribe date and treatment. Courts shall enforce	Removal of not less than 45% of suspended solids, complete removal of settleable solids and any higher treatment needed.	None specified.	Consent of Congress given for other Ohio river states to become members.
New England Interstate Water Pollution Control Commission	Massachusetts, Connecticut, Rhode Island, and New York, Vermont, Maine and New Hampshire are eligible to join.	All interstate waters within area	To classify interstate water according to highest use and coordinate a mutually agreed upon plan to improve waters.	No powers to issue orders or to finance or construct treatment works.	Yes, see chart. All member states have adopted similar standards.	No	Compact pertains to all interstate waters rather than any one basin.
Tri-State Water Commission	South Dakota, North Dakota, and Minnesota	Red River of the North	A corporate body created to study problems concerning pollution of water supplies.	Authorized to review and approve plans for all waste disposal works on specified waters.	No	No	No disposal works may be constructed except with the approval of commission.

Footnotes—Three other interstate agencies concerned with pollution are (1) Atlantic States Marine Fisheries Commission, members: Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, South Carolina, and Virginia; (2) Gulf States Marine Fisheries Commission, members: Alabama, Florida, Mississippi, Louisiana, and Texas; and (3) Pacific States Marine Fisheries Commission, members: California, Oregon, and Washington. These agencies are primarily concerned with the protection of fishing resources.

5 - Informal interstate agreements

Name	States subscribing to agreement	Purpose and organization	Remarks
Great Lakes Drainage Basin	Illinois, Indiana, Michigan, New York, Ohio, Pennsylvania and Wisconsin	To cooperate with each other and the U. S. Health Service to improve water quality.	
Missouri River Basin	Colorado, Iowa, Kansas, Missouri, Minnesota, Montana, North and South Dakota, and Wyoming	"To establish a permanent Basin Health Council composed of health officer and sanitary engineer from each state to promote a cooperative program for protection and improvement of the basin's waters.	No more than an informal committee.
Upper Mississippi River Drainage Basin	Illinois, Iowa, Missouri, and Wisconsin	Substantially similar to Great Lakes agreement, an added agreement provides for sanitary engineers to work together.	
Pacific Northwest Pollution Control Council	Oregon, Washington, Idaho, Montana, British Columbia and Alaska	To coordinate efforts of various pollution control agencies and standardize procedures used in each of states with requirements of each case.	Three committees are working, respectively, on standards and minimum requirements for disposal and treatment of industrial wastes; standards of water quality with particular emphasis on surface waters; and standards for design of sewage and industrial waste treatment plants.

Footnote—International joint agreements have been made with Canada to protect boundary waters. One such joint commission sets objectives for the waters of St. Clair River, Lake St. Clair, the Detroit River, and St. Mary's River from Lake Superior to Lake Huron. In this case the commission has set general requirements and specific requirements for certain kinds of wastes.

Legal Aspects of Water Utilization

Prepared by Melvin Nord, Associate Professor of Chemical Engineering, Wayne University

UNLIKE most substances, water in streams or underground is not susceptible of ownership as real or personal property. The reason is largely because of its fluidity, which permits it to flow from the land of one party to that of another.

Rights to the use of water, therefore, must take into account the relative situation of the various parties having access to it. For example, if a person situated upstream along a creek were suddenly to appropriate the entire flow for irrigation purposes, downstream proprietors would be unjustly deprived of their rights. Similarly, if the upstream proprietor were to pollute the stream it would interfere unjustly with the right of the downstream proprietors to use the water.

The rights and obligations of parties using the same water are correlative. It is apparent, therefore, that the apportioning of rights and obligations in the use of water among the various users is the principal legal problem in water utilization. The body of law concerned with this subject matter is generally called "riparian rights".

Legal Classifications

The law recognizes three types of water,—natural watercourses, surface water, and underground water.

A natural watercourse is a stream flowing in a natural bed or channel with defined banks and a permanent source of supply. The fact that the flow may, in times of drought, be diminished or suspended does not prevent it being a natural watercourse. It is sometimes necessary also to consider whether the stream is navigable.

Water flowing over the surface of land in no fixed channel is classified as "surface water", and is subject to different rules of law than that applicable to natural watercourses. When surface water drains into a lake or stream, however, it ceases to be surface water and becomes a part of the natural watercourse. Close questions may arise where water flows intermittently in creek beds.

Underground waters are of two varieties: If the water is merely percolating below the surface in no fixed channel, it is classed as "percolating water", and is subject generally to rules of law similar to those of surface waters. If, on the other hand, the underground water flows in a well-defined course, it is an "underground stream", and is governed by rules of law similar to natural watercourses.

Riparian Proprietorship

While the concept of riparian proprietorship principle is ordinarily discussed with streams, it is applicable to some extent to all kinds of waters.

The definition ordinarily given for riparian land is land bordering a natural stream or through which a natural stream flows. (The term "littoral" is sometimes used to characterize land bordering on a lake or sea.) A riparian proprietor is a person in legal possession of riparian land as owner or tenant. Borderline questions arise where municipality riparian proprietorship exists (1).

A more difficult question arises when a part of riparian land not bordering the stream, is sold. On this question, there is a conflict of authority among the various states. According to one view, the right to use water in a stream is derived from possession of land abutting the stream (2). The other view is that riparian rights constitute an interest in (i.e. a property right in) land which, when once attached to a piece of land, can be conveyed like any other interest (3).

Logical Difficulties

Each of these views is subject to logical difficulties. In the former, *sale* of land not abutting the stream terminates the riparian status, while leasing does not, since title to the property remains intact. According to the latter view, purchase of land adjacent to riparian land does not make such land riparian, so a given piece of property might be partly riparian and partly non-riparian.

To determine whether a given property is riparian, in the latter view, it is necessary to trace the title back through all its vicissitudes. Because it is simpler and less technical, the former view is best, and is the majority rule (4).

It is well established that the size and shape of land is irrelevant insofar as deciding whether it is riparian. Thus a small frontage is sufficient to make the land riparian. If part of the land is in a different watershed from the stream, it is sometimes said that such a portion is not riparian land. It is better, however, to say it is riparian, but that any substantial diversion of water to such land may violate the rights of lower riparian proprietors.

Natural-Rights Doctrine

In apportioning rights as among riparian proprietors along natural streams or watercourses, the "natural-rights" doctrine is the oldest rule. In most jurisdictions (other than the western states), some vestiges of it still remain.

According to this doctrine, riparian rights are "natural rights", recognized as growing out of the "natural" wants of man. It means that all riparian proprietors have the right to obtain the water in its "natural" state and undiminished in quantity below the "natural" quantity. This rule is, however, subject to the privilege of any riparian owner to use the water for his "natural" wants.

Ordinary Use

Thus, those who lawfully occupy riparian land have a right to "ordinary" use of the water for such "natural" or "domestic" wants as drinking, washing, cooking, watering animals and other things necessary to preserve life and health. This right to use water for "ordinary" purposes is unlimited in extent: Even if these uses entirely exhaust the supply of water so downstream proprietors get none, no liability is incurred (5).

But when the use is "extraordinary"—such as for irrigation, manufacturing, or diversion of water to non-riparian land—the privilege is strictly limited. Thus, according to the natural-rights doctrine, a riparian proprietor may use water for "extraordinary" purposes only if they cause no "perceptible" diminution in quantity or impairment in quality (6).

Consequently, any unprivileged use of water, which violates the right of other riparian proprietors to receive it

in its "natural" state is immediately actionable. Thus, even if no *actual* injury has been occasioned by a lower riparian proprietor, he must bring action when this *technical* violation of his rights occurs, or run the risk of losing his rights by prescription if he waits too long. Under the natural-rights doctrine, the same holds true on pollution. On the other hand, if the unprivileged use is continuous, an injunction may be granted a lower riparian proprietor, even though he is not suffering any actual damage, because this is necessary to prevent the acquisition of a prescriptive right.

Advantage of the natural-rights doctrine is said to be that it is definite, so each riparian proprietor knows what use he can make of the water. Actually, however, this advantage is somewhat deceptive, because of the vagueness inherent in the concept of "perceptibility".

The disadvantages of this doctrine are very serious, since it prevents many beneficial uses of water, which would not cause injury to anyone. While the natural-rights doctrine may be satisfactory in some rural areas, it is decidedly inadequate for industrial or arid regions. In most of the United States, the natural-rights doctrine has been supplanted (at least in part) by other doctrines.

Reasonable-Use Doctrine

The reasonable-use doctrine may be regarded as a modified form of the natural-rights doctrine. It may be stated thus: A riparian proprietor has a right to have the water come to him undiminished in quantity and unimpaired in quality, *except* insofar as dimmution or contamination is inseparable from a reasonable use of such water. What reasonable use is, can be ascertained only from a study of the facts in a particular case, and is a question to be decided in a lawsuit. Factors such as the following determine whether a given use is reasonable; its extent, duration, necessity, the nature and size of the stream and the uses to which it is put, and the extent of injury to one proprietor and benefit to the other (7).

No action can be brought by a lower proprietor unless and until he is actually injured by the practices of someone upstream. Thus, riparian rights cannot be lost by prescription unless an actual injury is acquiesced to by the lower proprietor. Furthermore, not every injury is actionable; the practice of the upper proprietor must be unreasonable if there is to be liability. Another difference between the natural-rights and the reasonable-use doctrines is that, in the latter, reasonable non-riparian uses are permitted.

Some courts utilize a doctrine, which is a combination of the natural-rights and the reasonable-use doctrines. They permit unlimited use of water in connection with "natural" or "ordinary" uses, and reasonable use in connection with *artificial* or *extraordinary* uses.

Prior Appropriation

In most of the arid western states the doctrine of prior appropriation has been adopted.

Here, the riparian proprietor who first takes the water for use obtains the right to prevent other riparian proprietors using the water in such a way as to interfere with his prior appropriation (8). In this case, the right of the prior appropriation is not limited to "ordinary" uses, or to uses only on riparian land. It is more nearly an absolute right than is obtainable in the reasonable-use doctrine.

The advantages of the prior-appropriation doctrine are said to be its certainty and the broad utilization of water permitted by it. But it is not always easy to prove exactly what quality and quantity of water has been appropriated. In addition, the utility of the use by the prior appropriator cannot be questioned, so the most beneficial uses are not necessarily obtained.

The doctrine of prior appropriation has been adopted in Montana, Idaho, Wyoming, Nevada, Utah, Colorado, Arizona, and New Mexico. In addition, a modified version of the doctrine of prior appropriation has been adopted in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Washington, Oregon, and California. Modification of the doctrine in these states provides that prior appropriation is significant only if it occurred before the land bordering the stream passed out of Government ownership (9).

The present California law entitles all riparian proprietors and prior appropriators to such use of the water "as shall be reasonably required for the beneficial use to be served". If any surplus above these needs is present at any time in the stream, it may be captured by anyone without liability (10).

Underground Water

Underground waters flowing in a well-defined course are governed by the same rules as apply to surface streams (4). In the case of ordinary percolating water, however, two distinct rules apply in different jurisdictions; the law of capture and the reasonable-use doctrines. The reasoning behind the use of the law of capture is that the owner of land owns all the minerals (including water) beneath the land (11).

Where the law of capture is applied, an owner may take all the percolating water he can from beneath his property, despite the fact that in so doing he actually may be withdrawing water from beneath his neighbor's property. In the arid states, the doctrine of prior appropriation is applied to underground water as well as to surface streams (12).

Nuisance Doctrine

The nuisance doctrine is a broad rule of law applicable to all occupiers of land, rather than to riparian proprietors alone. It is, by the same token, an alternative theory in riparian cases. As a practical matter it is primarily of use between riparian proprietors in stream-pollution cases (13) (14). A nuisance is defined as an unreasonable interference with the right of an occupier of land to make such use of it as he pleases. As applied in riparian cases, therefore, there is very little difference between the nuisance and reasonable-use doctrine.

In states that apply the reasonable-use doctrine in riparian cases, the remedies applicable and the result should be the same whether the action is based on riparian rights or on nuisance. In other states, however, the nuisance doctrine is in principle inapplicable to riparian cases. In a stream-pollution case, the court may completely ignore the fact that, according to its riparian law, no perceptible pollution is permissible, and may decide that according to nuisance law, a "reasonable" amount of contamination of the water is permissible (15).

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Problems Connected With Water-Pollution Abatement

A RECENT SURVEY of more than 3,000 industrial plants by the National Association of Manufacturers and The Conservation Foundation reports, "The nation has by no means reached the limit of its water resources." The study further observes, "Only about three-quarters of an inch of all rainfall is intercepted annually and used directly by man."

In regard to the problem of water pollution the report continues: "30% of the reporting plants say it is moderate in their localities, 29% think it is practically non-existent and about 25% believe it to be slight. Only 17% expressed the belief pollution is serious in their areas.

"This pattern holds almost exactly in the Chicago area. In New York and Philadelphia, especially the latter, a greater than average percentage believes that pollution is serious, and comparatively few consider the problem practically non-existent.

"Concerning the treatment of water, fewer than half the respondents reported having any facilities. Of those having treating systems, the largest number use them to treat water prior to its use in the plant. About 82% of the plants apply no treatment to their waste water—but it was emphasized that this figure includes many plants in which treatment is not necessary."

The survey also found that 60% of the plants do not re-use any of the water they take in. Most of the remaining plants re-use less than 50%, but a considerable number of them re-use much greater amounts.

From the standpoint of water pollution, the preceding tabulations show what laws and regulations have been put on the statute books. They picture what the future may hold for industry in other areas because, from past experience, we must assume that newly proposed legislation will be patterned, at least to some extent, after laws in force elsewhere throughout the nation.

Federal Law

And, since state regulations are backed by federal laws (Public Law No. 845) it behooves engineers working through professional groups and societies to take their rightful place in formulating future pollution-abatement programs. Only in this way can they be sure their particular problems will receive complete and sympathetic consideration.

Get ready to cope with the problem by studying state legislation, regulations enforced by interstate compacts, references included in this report and the following: "Federal Public Law No. 845; "House Document No. 266," 78th Congress; and "Suggested State Water Pollution Control Act," compiled by the Federal Security Agency, Public Health Service, Div. of Water Pollution Control. Also consult industrial associations for studies and developments of this problem as it affects their member companies.

Regardless of personal feeling, some action must be taken on water pollution. Aside from it being a public nuisance, industry alone spends millions of dollars annually to replace equipment eaten up by corrosion from mineral acids and acid salts or dissolved gases such as ammonia, hydrogen sulfide and carbon dioxide—products of anaerobic decomposition of organic matter in our streams.

Some states have held that where a downstream riparian owner suffers loss through stream pollution traceable to the non-negligent and necessary operation of an essential industry, the industry has the legal privilege of continuing the pollution.

This seems to apply only where the

With settling basins, the soil is dried, plowed and harrowed between fillings to hasten seepage and prevent unpleasant odors

Things You Must Consider About Waste Treatment

Summary of anaerobic digestion based on several years experience

Waste	Yeast (Molasses)	Butanol (Grain)	Yeast (Molasses)	Trickling-filter sludge	Ohio Distillery (Grain)
Flow, gpd	222,300	300,000	160,000	2,000	500
Tank, gal	2.2 million	3 million	623,000	40,000	7,200
Volatile solids, %	1.85	3.0	0.7	3.5	3.0
BOD					
Raw	10,000	17,000	5,000	——	16,000
Effluent	2,000	2,420	1,500	——	1,600
Removal	80%	69.8%	70%	——	90%
Loadings, lb per cu ft per day	0.188	0.114	1.84	0.10	0.143
Gas, cu ft per lb	5.0	9.3	4.25	9.2	11.0
Vol per tank vol	0.525	1.06	0.43	1.0	1.5

From: "Design and Loading Factors for Anaerobic Fermentation Plants", by Arthur M. Buswell — Proceedings of the Fifth Industrial Waste Conference, Don. E. Bloodgood Chairman, Purdue University.

sufferer is an individual and not to the general public. Such pollution is called an intentional non-trespassing invasion of the property of others and, under common law, will not be restrained or punished by assessment of damage, if the gravity of the harm is outweighed by the utility of the pollutor's conduct. The pollutor may have a privilege, but it is not a property right, and it is good against individuals, but not the public. A latecomer on a river can really be low man on the totem pole.

A few regulations provide for classification of streams. Supposedly with the intent of gradually reducing pollution over the years, the laws say new industries producing objectionable wastes cannot be started unless they provide for waste treatment, the degree depending upon the stream classification at the proposed site. In other words, new industries must treat their wastes in such a way as not to add to existing pollution load on streams.

Stream Classification

At best, stream classification is only a stop gap. At its worst it is a form of discrimination, because it tells one group what it can or cannot do as compared to another group over the hill. It also works a hardship on a new industry, because lack of space on one stream may force the plant to locate where pollution abatement is tougher. Result is migration of new plants to areas having more freedom.

In like manner, discrimination enters the picture when the diluting ability of a stream is allowed to affect permissible waste discharge. It penalizes industry situated by the side of a small stream to the advantage of a competitor located along a large river. Or again, it can operate against a plant desiring to locate on a stream that is already loaded near its absorbing capacity by other pollutors. If we are to have water-pollution abatement laws, let's apply them uniformly throughout the states in such a manner as to prevent them being used by unscrupulous competitors, and as political footballs.

Proposed legislation should define industrial-waste pollution in such broad terms as to catch all conceivable contributing factors leading to stream degradation. Broad definitions would catch the lone plant putting low amounts of contamination in streams to no one's injury, but where intolerable conditions would arise if others did likewise. Equality legislation would also ignore such factors as stream-flow volume, dilution and self-purification of flowing water.

Unfortunately, politicians, pressure groups and the general public are sometimes prone to push through legislation just to get it on the books, without investigating its workability. They frequently fail to take the time and care to prepare a proposal that will bring the best results with the least number of headaches for everyone concerned. Here is where engineers who shoulder the responsibilities should watch their interests and act to prevent these hasty decisions.

Take a look at conditions in the New England States. Here many mills stand in such cramped space that they have absolutely no room to install treating plants. Enforcement of thoughtless legislation could work a real hardship on them. They would either have to hang treating equipment on skyhooks or move to another area.

But don't overlook this fact—the hue and cry for cleaner streams is going to continue, and get louder as time goes on. Sportsmen know that streams could and should contain fish. Boating and swimming enthusiasts want clean water for their sports. These groups are actively working for what they want and will not stand for smug denials or stock alibis.

Public Relations

The days of "The public be damned" are over. If you have a waste problem, discuss it with the community. Keep the people informed through the local papers and don't try to hide behind the cloak of "'tisn't so." Show you are making an honest effort to correct conditions. Everyone, including industry, wants a clean water supply and that is where new plants will be built. The public is becoming increasingly aware of this and communities are determined to act before their growth is stymied.

States having the most serious pollution problems are the ones that have taken the most determined stand against it, and as conditions become worse in the presently less-populated areas and states the demand for pollution abatement will become more insistent. Ultimately, most plants will be forced to clean up their waste effluents to the point where, in conjunction with all other waste effluents, their's will not in any way adversely affect either municipal sewage-plant operation or stream life. This will eventually mean two treating systems.

Re-use Treated Water

Sensible answer here is to plan on re-using treated waste water and keep initial clarification plant small. Farsighted engineers and business men know it costs money to clean water. If forced to clean it twice, re-use of treated waste will cut down initial treating costs and, in the case of a new plant, reduce the initial investment. Another saving can be instituted by policing the water-using operations and cutting out useless waste.

Many important factors enter the picture of industrial-waste treatment and getting expert advice at the start will save you dollars and headaches later. To find the best solution, you must thoroughly understand each process producing the waste and realize that here is the place to start, rather than where the plant's dump line empties into the stream. It's also a good idea to talk to neighboring engineers—you may be able to combine wastes from two or more plants for low-cost neutralization. Or, perhaps a common treating plant will solve the problem most economically. Preliminary studies must be complete and exact.

An intelligent approach to the job may show that certain wastes can be dumped into the municipal sewers. But watch things like animal grease—they clog the lines, and concentrations of certain metallic salts like cyanide waste —they upset the biological activity of the sewage-treatment process.

Under some conditions industrial

wastes may have a beneficial effect on the receiving stream—those containing neutral non-toxic nitrates help where the stream's de-oxygenation exceeds its re-aeration. On the other hand, lower aliphatic acids such as acetic, while not seriously affecting the water's usefulness, do have a high oxygen demand.

The temporary advantage of mine-acid drainage in retarding the decomposition of raw sewage, and thus preventing the development of obnoxious conditions near its entry to the stream, is well known. Communities often take advantage of this pickling action and dump raw sewage into nearby streams. This takes care of the immediate neighborhood as far as stench is concerned, but where dilution and neutralization occur downstream, decomposition of the sewage sets in where the area should be clean.

Acid Drainage

In certain areas mine-acid drainage represents the most serious polluting substance, and to date no practical solution seems to have been developed. Perhaps this is a problem that needs a little pressurized interest stirred up in it. It's a big job, but equality before the law certainly demands that all stream polluters be treated alike.

The U. S. Public Health Service at one time estimated that the Ohio River and its tributaries received the equivalent of 2,500,000 tons of sulfuric acid a year from mine drainage. This is still a conservative figure. How much steel, in the way of industrial equipment, does this acid destroy in a year? How much money is spent yearly for painting, etc. to protect the steel against this acid? Does the cost of destruction and protection approach the value of the coal being mined?

One river in another district picks up such a load of mine acid in its first fifty miles of flow as to render its water unfit for acquatic life. Then it receives caustic waste from a paper mill that brings its pH to neutral, but which increases the BOD to such a point that aquatic life still cannot exist. From here on the river receives so much industrial waste and sewage that it is unsafe for recreational sport, and unfit for industrial use without complete treatment. Nothing more than an open sewer from source to mouth.

Taking a long-range view of the water-pollution situation, chances are the future will bring stringent regulations requiring that plant effluents be cleaned of all harmful substances before they are discharged into our streams, lakes and underground supplies. Faced with such a possibility, why plan elaborate treatment for waste water and then throw it away.

Cut Clarification Costs

Very few plants can use surface water for process without at least some form of clarification. Consequently, if the law says plant effluent must meet high standards, and it costs X dollars to remove the waste products, re-use of the water will at least cut original clarification costs. Here is how other economies can be instituted:

1. Re-use process water for cooling and other purposes.
2. Re-use water from heating and cooling circuits at lower and higher heat levels respectively.
3. Use sewage-plant effluent for cooling purposes.
4. Re-use process water at higher concentration levels.

Water is becoming more and more an important engineering material and ways to husband it frugally must be explored. Economy within the plant calls for elimination of wasteful practices, for installation of multiple water systems, recirculation and re-use of water and reclamation of useable water from plant effluents. A good start is to discourage the practice of "wide-open valves." Teach plant operators to use less water. Also make the water source fit your needs—it is uneconomical to use water of better quality than necessary to do the job. Diversion of cooling water to process has proved profitable in ceramic industries.

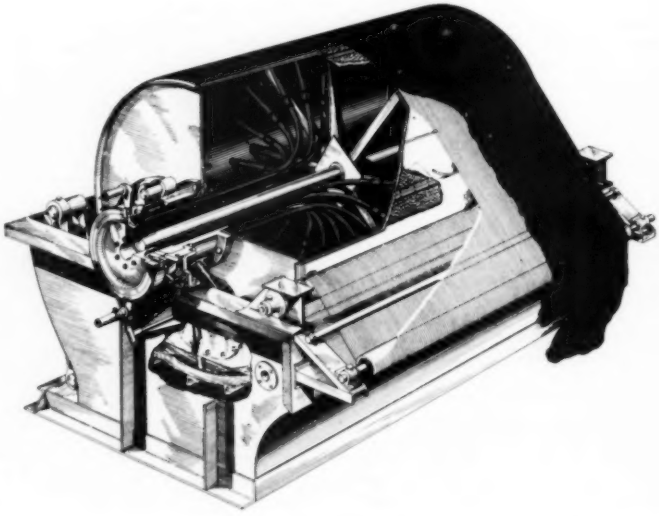
Plants dependent upon underground supplies have learned the value of frugality the hard way. Receding water table from overuse of underground supplies located near shoreline means salt-water contamination. Long Island now requires the return of cooling water to the ground via diffusion wells and seepage basins.

A west coast steel plant, operating on a limited supply recirculates cooling water and re-uses effluent from its sanitary and industrial waste-treatment works. All waste water is completely treated and re-used.

Sewage Effluent

A steel mill along the Schuylkill River draws only enough water from the stream to make up losses. Water is diverted to the river only when the ready supply exceeds demands and the returned water is treated. Bethlehem Steel at Sparrows Point purchases sewage-plant effluent to supplement its under-ground supply, which was becoming contaminated with salt. It now processes this water by coagulation, settling and chlorination to get a usable industrial product.

Many waste-treatment problems will require laboratory research and pilot-plant tests before final equipment and process can be designed. Phenol wastes are now coming in for wide study. The Ohio River Valley Water Sanitation Commission sponsored coordination in joint research with Armco Steel Corp., Wallace & Tiernan Co., Ozone Processes Div. of Welsbach Corp., and Mathieson Chemical Corp.



Rotary vacuum filter removes sludge from slurry liquids and de-waters it for drying or haulage to disposal

Ohio State Health Dept., Div. of Sanitary Engineering furnished a mobile laboratory and assisted in the analytical work. Important help also came from the Cincinnati Environmental Health Center of the U. S. Public Health Service.

Conversely, there are numerous applications where the pattern of waste composition, treatment and equipment design is well established on experience gained from existing installations. For instance, the chemical flocculation and precipitation process and equipment, familiar to the water-softening field, can be used to remove a great many waste products.

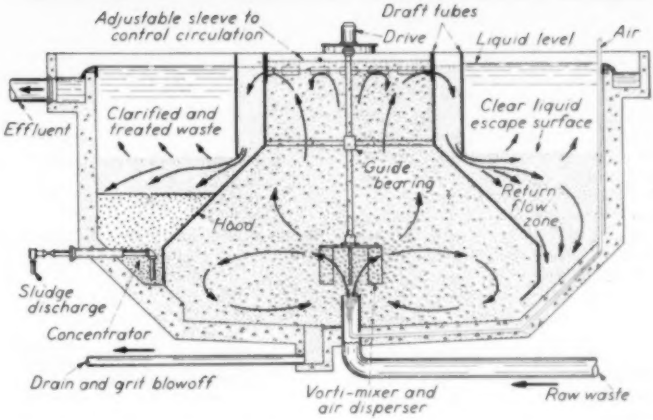
Organic Wastes

Many industries will require biological treatment to reduce the BOD of organic wastes. This can take the form of a trickling filter—a deep bed of crushed stone encased with biological organisms over which the water trickles, or a type of activated-sludge device—tank or mechanical clarifier. Both systems allow for the growth and activity of aerobic bacteria—micro-organisms that live in air and eat organic material. Therefore, adequate air admission and uniform dispersion is a must. The mechanical clarifier used for this job quite frequently replaces primary sedimentation, biological filter and final sedimentation.

Another method (anaerobic) utilizes baceteria that live in an absence of air. Heat is sometimes applied to the tank to speed the process. Gas given off by the digestion process can be vented to the atmosphere or used as fuel. This method is frequently used to digest organic matter in sludge residue from other treating processes.

Recent investigations have produced favorable results from anaerobic treatment of highly organic wastes such as those from distilleries, starch plants, strawboard mills, milk processing operations and sugar plants. Tests have brought out the need for proper mixing, circulation and temperature control to obtain the desired results. Using these digesters for the pretreatment of wastes having unusually high organic content greatly reduces the load on subsequent units. With detention periods of 48 hr such a device effects a BOD reduction of from 70 to 90%.

A catalytic-oxidation process for destroying organic wastes, originated and directed by D. V. Moses of Du Pont, can be used to treat vaporized waste with air. Present indications also show it may be adaptable for use on liquids. So far, good results have been obtained with catalysts containing oxides of copper, chromium, manganese, nickel and cobalt. Copper chromite will be used in a new plant at Belle, W. Va. to destroy such organics as formaldehyde, methanol, formic acid and ethyleneglycol derivatives.



Mechanical clarifier fitted with air supply to influent section takes care of coagulation, sedimentation and BOD reduction on various kinds of organic wastes

The end product of all treating processes is sludge, which can be dewatered with vacuum filters, by solar drying in lagoons or beds, spray driers or centrifuges. When dry it can be burned or mixed with the soil.

Wells Cause Trouble

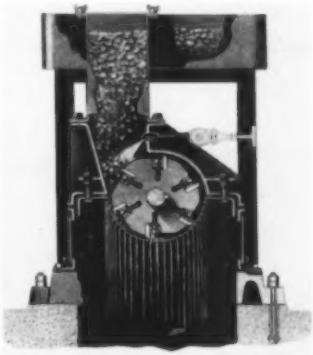
Wells have been used to dispose of industrial wastes, but this method can lead to trouble. A well for this purpose must be drilled considerably lower than the useable water table and it must terminate in a permeable strata. The danger of contaminating nearby wells is ever present and may take several years to show up because underground water moves so slowly. Also, once contaminated, the pollution remains for years. Another objection to well disposal is the fact that the waste water must be clear and chemically stable to avoid plugging the subsurface formation. Lagoons used for evaporation and seepage can be resorted to if there is no danger of contaminating underground water.

The discussion so far gives a condensed version of the major problems to expect and points out the need for caution. You may know more about the general handling of your plant wastes than outside engineers, but chances are you have been looking at them largely from the processing end, and have given very little thought to their characteristics from the removal standpoint.

Here is an example of a wrong start: A plant manufacturing ceramic and metallic parts proposed to install settling tanks and auxiliary equipment to treat approximately 45,000 gal of waste water a day. A detailed and careful investigation of the plant's water-use practices proved that more than half the water was wasted. It also showed that about 15,000 gal could be segregated and discharged without treatment. Final decision was to design a system to treat 6,000 gal a day, a capacity entirely adequate.

Situations like this prove the need for painstaking studies to find the most economical way out, because every expense added to the manufactured-product cost means a higher selling price. And in a highly competitive market, survival means keeping costs down.

What about your present system of plant waste-collection and disposal piping? Every section may be tied into



Grinders reduce the size of particles in organic wastes from canning plants, tanneries, etc. for easier treatment

a common line, or two identical waste lines may tie in at widely separated points. Or, you may have pickling liquor from one building, cutting-oil refuse from another, and alkali wastes from another, etc., all mixing together with plant sewage in the main outfall.

First, you must determine whether plant piping must be separated. Second, find out how much and what kind of waste can be dumped into municipal sewers without harm to the sewage plant. Third, determine if blending of two or more wastes will prove helpful before treatment.

In one plant it was found that oil from turbines, compressors, gearboxes, etc. and spoiled coolants from machine tools were permitted to enter floor drains. Drip receivers were installed and the refuse was dumped on the plant coal pile. Don't overlook the possibility of using calcium-carbonate and magnesium-hydroxide sludge from water softeners to absorb oil and organic substances.

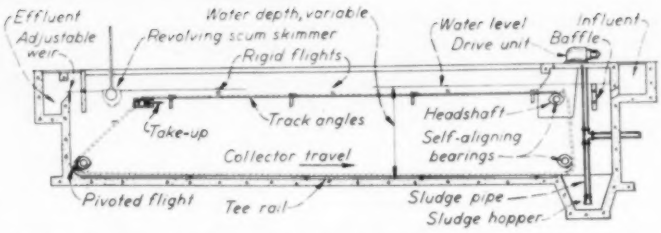
Choice between continuous and batch treatment depends on the concentration of wastes and the economics of using automatic control, as compared to the cost of large tanks.

Study Costs and Savings

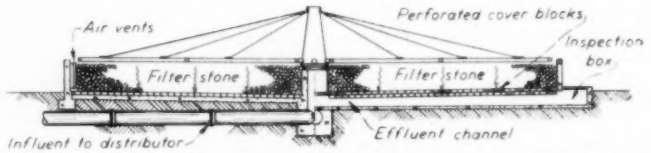
Costs must be kept down. Always keep in mind the possibility of recovering pay-the-way products—they mean lower operating expenses. Take a look at the following examples:

A ground-wood paper mill reports savings averaging $268 a day, and a soda-pulp mill saves $332 a day by reclaiming otherwise wasted material.

Sulfite liquor from pulp mills is now reclaimed for use in making yeast, alcohol dispersives, tanning compounds, vanillin, etc. With good flyash collectors now available, calcium-base sulfite liquor can be evaporated and burned as power-producing fuel. Some mills are switching to the magnesium-base process, while others are experimenting with the ammonia-base method of pulping for easier disposal.



Rectangular sedimentation tank equipped with skimmer to get rid of floating scum



Filter bed of crushed stone coated with bacteria reduces BOD of organic wastes

Brewers and distillers are reclaiming waste that can be processed into excellent yeasts, livestock feeds and vitamin products.

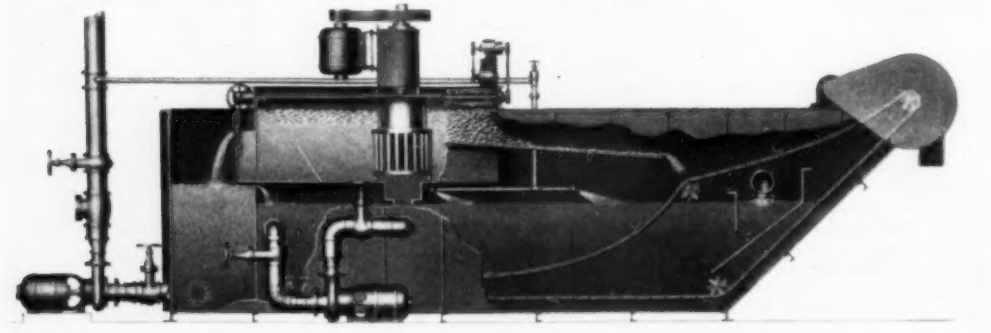
A steel mill installed washing equipment and clarifiers to remove blast-furnace flue dust. During the first year of service the system reclaimed enough ore dust to pay for its installation and operation. In the corn product and distillery industry, recovery has become profitable. The distillery residue, formerly wasted, is now recovered to the tune of $30 a ton. Recovering sulfuric acid from pickling liquor effected a saving in the cost of new acid and consumption of alkali formerly needed for neutralization.

Professors W. L. Lea and Gerard A. Rohlich, department of civil engineering, University of Wisconsin, recently developed a method of de-phosphorizing sewage effluent to reclaim valuable material formerly going to waste. The process is said to remove not only 99% of the phosphorous, but also cuts the organic nitrogen 60% and the BOD 84%. Industrial-plant engineers may find use for this method on phosphorous-containing wastes.

Plating plants have an especially difficult problem because they must dispose of such chemicals as sulfuric and nitric acids plus cyanide, chromate and solutions of metal salts like nickel, silver, copper and potassium. Removing the metal ions is usually simple, add a caustic and precipitate them as oxides or hydroxides.

Cyanides are so toxic that one pound of sodium cyanide requires nearly 1,500,000 gal of water dilution to render it non-toxic to trout. It is also harmful to bacteria found in sewage-treatment processes. The wastes can be treated with oxidizing materials such as potassium permanganate, hydrogen peroxide

Removing suspended solids by flotation with air bubbles may find use on soap wastes, white water, oil-refinery wastes, etc.



and chlorine. These change cyanide to cyanate or carbon dioxide and nitrogen. Some states do not permit the cyanate form, insisting it be converted to carbon dioxide and nitrogen. The lime-sulphur method leaves residual cyanide and a considerable amount of sludge.

Some plants remove cyanides by running the waste through a mixing basin where caustic-soda solution is metered and added through a regulating valve actuated by a pH controller. Passing through an agitator section the waste is chlorinated and again agitated, after which the cyanide-caustic-chlorine reaction takes place. Sometimes a side reaction occurs that produces nitrogen trichloride, hence this method requires thorough ventilation. Final settling and filtering remove the sludge.

Chromium in its hexavalent form is toxic to fish in concentrations of 5 ppm and to sewage digestion bacteria in amounts of 0.5 ppm. A common method of reducing it to the trivalent form is with copperas or ferrous sulfate. In concentrations below 500 ppm it can be reduced by passing the waste over steel filings. Installations have been made using sulfur dioxide as a reducing agent with considerable success.

Another headache in plating plants is the rinse water. Drag-out from plating and dip tanks can be reduced by longer drainage of parts and by tipping cup-shaped objects to spill residue. Switching from a continuous runover to a batch rinse permits segregation and separate disposal of cyanide waste. Rinse water frequently can be re-used after the cyanide has been neutralized and precipitated.

In general, acid waste can be neutralized by passing it through filter beds of limestone or adding lime. Wastes containing highly oxidizing or reducing components require neutralizing additives before being discharged. Ion exchangers play an important part in waste treatment and material reclamation. They can be used to recover metals from rinse water in plating operations, rayon manufacture, metal industries and sodium from pulp liquors. Other jobs they can do are remove aluminum and iron contaminants from chromic-acid baths, and concentrate dilute cyanide in rinse water for easier disposal.

Oils and greases will bring their share of headaches. Filters and skimming chambers will work on free oil, but the emulsified kind may require acid cracking to remove it.

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Common Methods Used to Treat Industrial Wastes

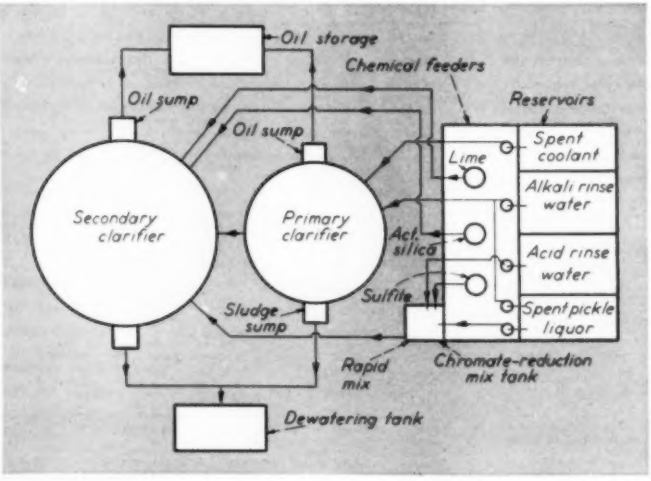
Removing soluble oil and plating acids

PLATING and machining operations in the manufacture of automobile parts produce wastes such as spent pickling acid, coolant, alkaline detergent solutions and acid rinse water. To meet state sanitary requirements, it was required that the final discharge from the plant be alkaline, containing on the average not more than: (1) 30 ppm of soluble oil, (2) 20 ppm of suspended solids and (3) 2 ppm of chromium as CrO_3.

The quantities and rates of production of the various wastes are about as follows: (1) spent pickling acid—2,500 gal discharged once a week containing 3,800 lb of sulfuric acid and 2,150 lb of ferrous sulfate; (2) acid rinse water—41,800 gal discharged daily containing 7 lb of sulfuric acid, 7 lb of ferrous sulfate and 2.5 of chromic acid; (3) spent coolant—17,800 gal discharged semi-annually containing alkali equivalent to 500 lb of sodium oxide, and 4,200 lb of soluble oil; (4) rinse water—62,500 gal discharged daily containing alkali equivalent to 460 lb of sodium oxide, 8 lb of soluble and 550 lb of insoluble oil.

Miscellaneous wastes consist of 800 gal every two weeks, 300 gal twice a week, and 600 gal once in three months, containing alkali equivalent to 920, 40 and 24 lb of sodium oxide respectively, the 300 gal of waste also containing 70 lb of soluble oil.

The balance sheet of total acids to be neutralized against total available alkalies works out as follows: Total acid equivalent of sulfuric acid and ferrous sulfate, in terms of sulfuric acid, 5,250 lb a week. Every other week total alkali equivalent of alkaline wastes discharged daily and twice per week, and assuming withdrawal of spent coolant from storage at the rate of 1,800 gal per week, in terms of sodium oxide; 2,350 lb per week, equivalent to 3,700 lb of sulfuric acid, or an excess of acid of 1,520 lb per week.



On alternate weeks, additional alkali is discharged with a sodium-oxide equivalent content of 960 lb which, added to the regular alkali wastes, provides a sodium oxide equivalent of 3,310 lb, equivalent to 5,200 lb of sulfuric acid, or an excess of acid over alkali during these alternate weeks of 50 lb a week. The deficits in alkali requirements are met by feeding lime to the waste water.

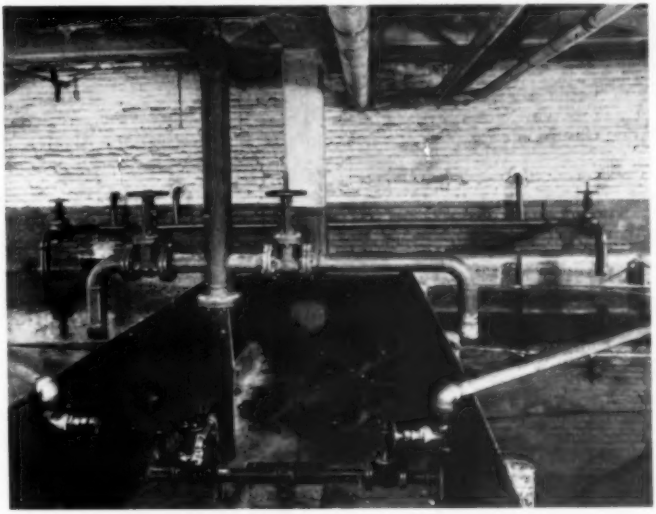
Treating-plant equipment comprises dry chemical feeders for lime and sodium hydrosulfite or sodium bisulfite, activated silica, necessary flow controls, pumps, primary clarifier for removing the bulk of oil from alkaline wastes, and a secondary clarifier for neutralizing acid wastes and removing precipitated solids resulting from this reaction.

Spent coolant and alkaline wastes containing soluble and insoluble oils are treated with spent pickle liquor to reduce their pH to between 5 and 6. This breaks the emulsion and causes the oil and any iron hydroxide precipitate to separate from the water as a floating scum, which is removed by a hydraulic skimmer and burned.

The partially clarified water then flows from the primary to the secondary clarifier where it, together with acid rinse water and waste pickle liquor are treated with hydrated lime and activated silica—sufficient lime being added to raise the pH of the mixture to 8.5 or above to insure precipitation of the ferrous sulfate hydroxide, which, aided by the activated silica, serves to coagulate suspended solids.

Prior to its delivery to the secondary clarifier, the acid rinse water passes through a mixing chamber, where additional pickling liquor and sodium hydrosulfite or sodium bisulfite are added to it for the reduction of chromate. On subsequent addition of lime to the clarifier, the chromium is precipitated as chromic hydrate and thus removed.

Treating textile bleaching and dyeing wastes



Collecting headers, blending lines and detention tanks for treating waste from bleaching and dyeing. The orifice box in center controls the discharge of neutralized effluent

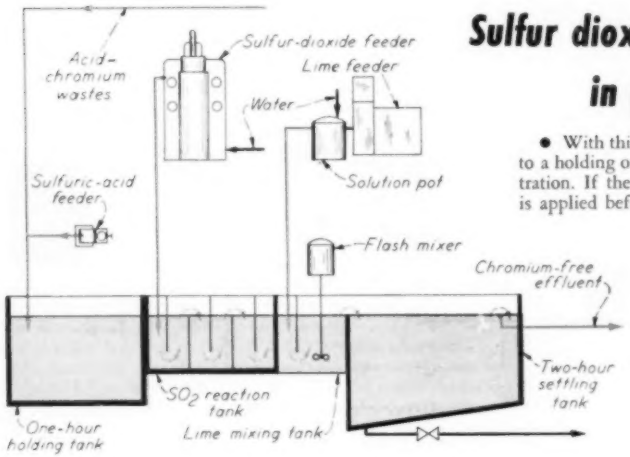
ONE EXAMPLE of economical waste disposal is the plant now operating at the Chester Lace Mills, Chester, Pa. In the original study the liquid wastes proved to be classifiable as very dilute, dilute and strong, and the first two could be disposed of without treatment. The strong wastes could be made acceptable to municipal sewers by (1) partially neutralizing them, and (2) regulating the volume of their discharge to avoid overloading the city sewerage system.

Two detention tanks, located beneath the bleachyard floor, receive the strong liquid wastes by gravity flow from the kiers and associated equipment. Waste liquids from such operations as wet-out, rinsing, kiering, bleaching, acid-sour, washing, starching and dyeing are composited in the detention tanks, which have a combined capacity almost double the estimated maximum strong-waste volume produced in one mill-operating day.

The two tanks are operated on a fill-and-draw basis. All strong wastes are dumped initially into one detention tank. At the end of the day, the operator tests the waste to determine its approximate pH. After adding the proper amount of 50% acid to bring the pH up to 8.0 he switches on a small pump, running it for one hour to assure thorough mixture of waste and neutralizer. The neutral liquors may then be discharged at a controlled rate, along with the dilute and very dilute wastes, to the municipal sewer system.

Effluent is discharged by pumping. Provided for the purpose is a heavy-duty duplex screenless sewage ejector with a discharge capacity of 450 gpm, and a 6-in. cast-iron line to a brick manhole at a nearby street corner where the effluent enters the city sewer.

An unexpected benefit resulted from the project: The preliminary survey indicated in detail the consumption of water in various operations, thus providing effective control of water usage at a time when the cost of municipal water had risen to a record peak.

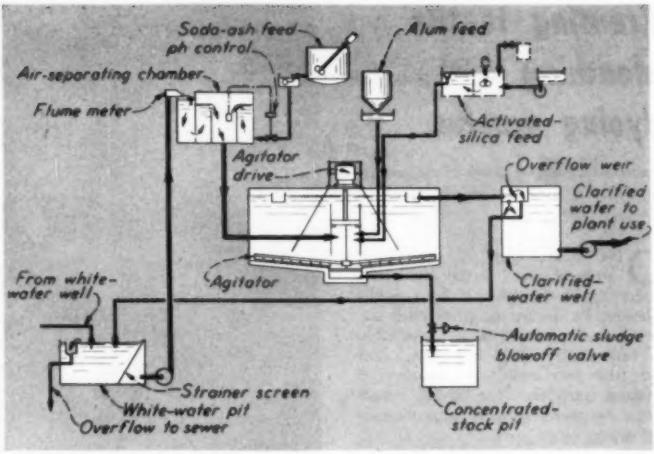


Sulfur dioxide destroys chromium in plating wastes

● With this method, the acid-chromium rinse wastes flow to a holding or equalization tank to smooth out the concentration. If the waste is not sufficiently acid, sulfuric acid is applied before it enters the holding tank. Then, as the waste enters the baffled reaction tank, enough sulfur-dioxide solution is introduced to destroy the color. The pH is then adjusted by adding lime in a small rapid mixing tank to provide precipitation of the trivalent chromium hydroxide.

Precipitation occurs in the settling tank with the chromium-free effluent going to the sewer, and the trivalent-chromium hydroxide being drawn off occasionally as sludge.

Reclaiming stock from paper-mill white water



STOCK, both fiber and filler material, discharged in white water from pulp and paper mills can be reclaimed by treating the water in a solids-contact clarifier. Intimate contact with the accumulated sludge blanket provides vast adsorptive surface to filter out the coagulated stock.

As shown in the flow diagram, an agitator pump in the reclaimer uptake mixes the water, chemicals and circulated solids. From here the mixture enters a conical flocculation zone where particles coalesce and chemical reactions are completed. Leaving the bottom of the cone, the solution flows upward through a settling section of increasing area.

Vertical velocity decreases, allowing light particles to settle out at the bottom of the conical section from where they are recirculated through the central uptake. Large particles settle on the bottom and are continuously moved to the sludge pit by the rotating scraper.

Coagulating chemicals are proportioned and fed to the clarifier as needed. Quite frequently sufficient alum and other coagulants are present in the waste water to do the job. Concentrated stock not re-used can be burned and the clarified water can be discharged without fear of polluting the stream, because it contains less than 0.25 lb of solids per thousand gallons.

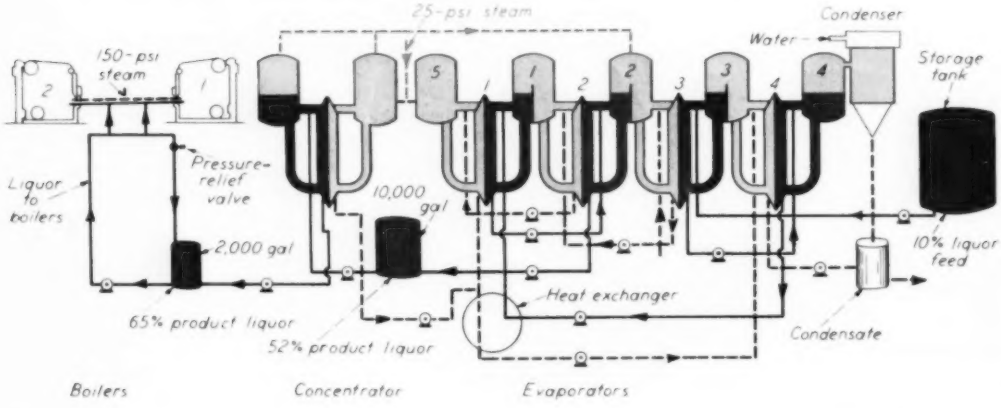
Calculations made on this system show that the material saved would pay off the original investment in about four years, after which savings above operating costs will be clear income. The plant treats about two million gallons of white water a day and recovers 2.25 lb of stock per 1,000 gal or 2.25 tons a day.

Incoming white water flows over an air-separator baffle and mixes with chemicals, if needed, in a high-velocity downtake. Bottom end of the downtake projects part way into the cone-shaped bottom of the main tank. Accumulated solids are suspended in the water as it flows upward from the cone-shaped bottom.

Water is clarified as it filters up through the sludge bed and coagulated particles drop to the tank bottom where they are drawn off.

Multiple-effect evaporators concentrate sulfite liquor

Typical system used for the evaporation and burning of spent sulfite liquor from calcium-base-sulfite pulp mill. Has blow-pit storage and direct feed to boilers



Biological-aeration treatment for organic wastes

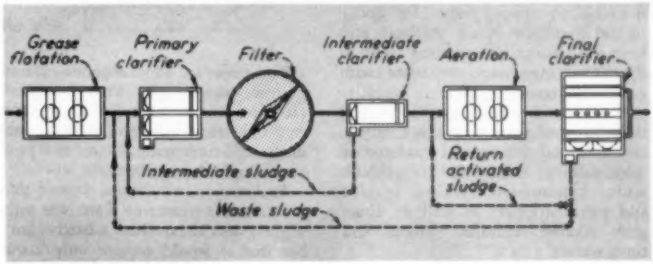
TREATMENT of canning waste is an exceedingly difficult problem, because of the complexities of the industry and the seasonal variations in waste flow. Although biological treatment does a good job on these organic wastes, many canning operations may be too short-lived to permit proper development of bacteria. Consider this fact carefully before deciding on biological treatment, otherwise results may be disappointing.

Chemical processes, either on a draw-and-fill or continuous-flow basis, are adaptable and can provide adequate treatment if properly supervised. The operating cost, however, becomes a matter of consideration. Although a considerable number of individual canning-waste treatment plants have been installed within the past decade, small seasonal plants should try combining cannery wastes with local municipal sewage for treatment in one complete plant. Treatment cost is usually materially less and the efficiency of treatment, from the pollution abatement standpoint, is greatly enhanced.

The best qualities of both the trickling filter and activated-sludge process combine to work symbiotically and give good results with this mixture (see sketch). The partially-oxidized and fresh effluent from the trickling filter is passed through the aeration tank. Under these ideal conditions the aerated-sludge process is dependable and not subject to the usual upsets. The resulting effluent is completely stable, has a low BOD and carries nitrates.

A plant of this type has been in operation for nine years and from June through September it is subjected to strong canning wastes of various packs. Typical final BOD results for these months have been 15, 26, 20 and 47 ppm respectively. The raw domestic sewage varied in BOD during this period from 179 to 440 ppm, while the cannery waste ranged from 455 to 3,690 ppm. Typical complete plant reductions during this period were 100% for settleable solids, 95% for suspended solids and 96% for BOD.

By cooperation with municipalities, a superior over-all result may be accomplished which is, at the same time, most economical for a canning plant.

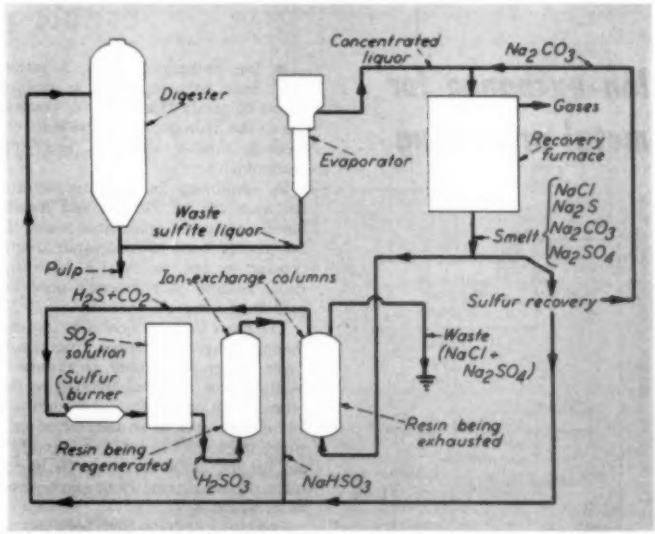


Recovering sulfite-pulp liquor

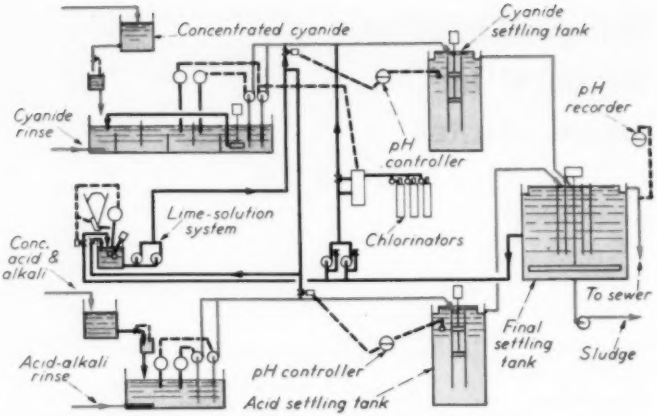
A PROCESS, which uses ion exchange, consists briefly of first concentrating the spent sodium-sulfite liquor in a multiple-effect evaporator. The concentrate is then fed into a furnace where smelt consisting mainly of sodium sulfide is formed, but also containing sodium carbonate, sodium chloride and sodium sulfate. Heat from the furnace is recovered.

The smelt, dissolved in water, goes to a settling tank where the insolubles separate. Part of the smelt solution is then passed through a weakly-acidic cation exchanger operating in the hydrogen cycle. The ion-exchange material adsorbs the sodium from the sodium sulfide and sodium carbonate, but permits the sodium chloride and sodium sulfate to pass through. This avoids objectionable build-up of chlorides and sulfates in the system and, at the same time, provides a harmless effluent, which can be discharged.

Hydrogen-sulfide gas generated in the column is meanwhile returned to the sulfur burner, where it is converted to sulfur dioxide. The sulfur dioxide can then be converted to sulfurous acid by dissolving it in water, and used to regenerate the resin. Final product of the ion exchange is, therefore, sodium bisulfite, which can be returned to the digester. Similarly, the untreated part of the smelt can be processed to recover the sulfur as SO_2, and the sodium as Na_2CO_3. In this way the desired ratio of recovered chemicals can be maintained.



Waste from electroplating operations



LOCATION of this plant made it necessary to get complete removal of cyanide with as complete removal as possible of copper, chromium, nickel and cadmium, plus neutralization of the waste to at least a pH of 7.0. Another design problem was to build the required-capacity plant (150 gpm) in the minimum space available and keep the amount of operating labor to the barest minimum, consistent with good engineering practice.

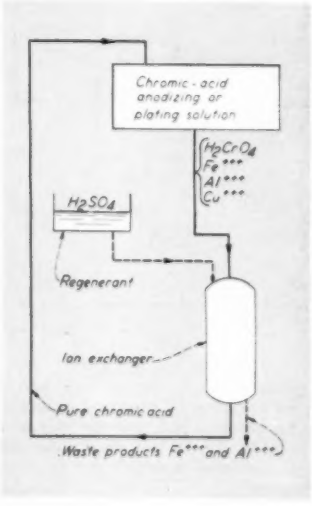
Wastes came from plating operations on small parts with silver, nickel, cadmium and chrome and consisted of nitric-sulfuric and 10% hydrochloric acids, concentrated alkalies, cyanide and paint strippers as well as dilute acid, alkalies, cyanide, chrome and rinse waters.

Collection system is installed so all wastes, both concentrated and dilute rinse, flow to four separate underground storage tanks. From here they flow into the respective dilute systems at fixed rates, making the maximum of the acid rinse water about 1,000 ppm at its highest concentration.

Preliminary calculations showed that a continuous-treatment plant was only slightly less cheap than a batch plant, but that it would require only about half the space. Also, it could pick up, with only slightly increased operator's time, to two or three shift operation, when and if necessary.

Cyanide-reaction tanks were designed to give sufficient (1) minimum time to guarantee complete reaction of cyanide to cyanate, (2) average time to guarantee 80 to 90% reaction of cyanate to nitrogen and carbon dioxide, and (3) volume with the permissible free chlorine to act as buffering capacity for minor variations in waste concentrations.

Ion exchange for metal processing



• Ion exchangers using a cation resin have been installed in plating plants to purify chromic acid. Operating in the hydrogen cycle, the units effectively remove aluminum and iron contaminants.

By employing ion exchange, stream pollution can be avoided and metals can be recovered from rinse water. It can also be used to concentrate dilute cyanide washes so only a relatively small volume of regenerant need be used to destroy the cyanide.

The brass industry now uses ion exchange to recover copper from rinse water. After the copper is adsorbed, pickling acid is passed through to regenerate the resin. The regenerant solution then goes to an electrolytic cell where the copper is removed. Another use for the cation exchanger is to recover copper or zinc from rayon-plant waste water.

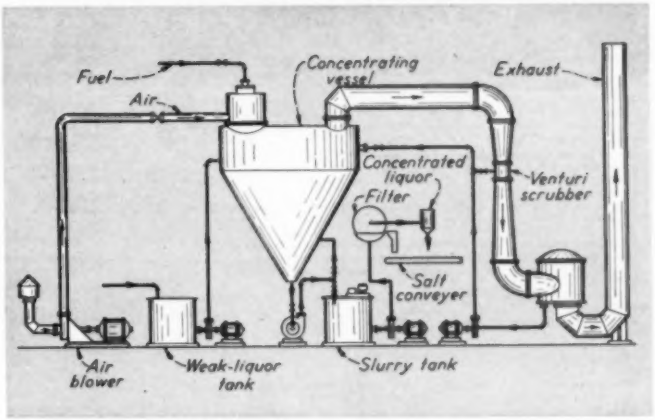
Promising systems have been developed with anion exchangers to recover gold and metals of the platinum group, customarily present in solution in the form of a complex acid. The same technique has been applied to the recovery of other metals such as molybdenum, vanadium and silver, which form anions in solution. Ion exchangers also can be used to recover ascorbic acid from citrus-fruit wastes, and tartrates from winery wastes.

Acid sludge + waste gas = fertilizer

• A recent project, involving a new process, turns two refinery wastes into a marketable product by manufacturing eleven tons of ammonium sulfate a day—a nitrogen-bearing fertilizer.

The process starts with waste refinery gases, which are bubbled through sulfuric-acid sludge, producing a solution of ammonium sulfate. This liquid is piped to another vessel where it is crystalized by partial evaporation of the brine. The resulting ammonium-sulfate crystals are then separated by a centrifuge and blown into a hopper from which trucks can be loaded by gravity. The crystals contain over 20.9% nitrogen.

Disposal of sulfuric acid and iron sulfate

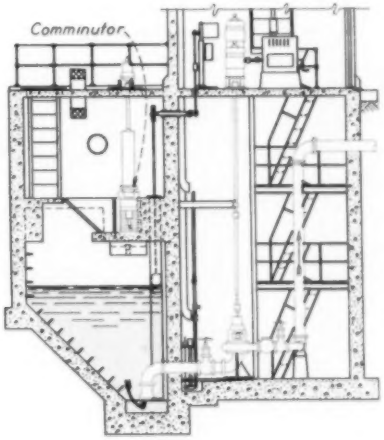


THIS SYSTEM is designed to process and reclaim waste solutions containing iron sulfate and free sulfuric acid from steel and titanium-pigment plants. The unit operates continuously with waste liquor charged in a steady stream. Part of the recirculating magma, consisting of precipitated ferrous sulfate and concentrated acid, is continuously withdrawn for filtration. The filtrate can be stored for use in the titanium plant or sold to superphosphate manufacturers. A scrubber eliminates fumes.

Recovered iron sulfate is mixed with about 12% of its weight of coal and a quantity of crushed oxide from the sintering machine, and extruded in the form of pellets. The pellets then go to the sintering machine where the entrapped coal furnishes sufficient heat to decompose the ferrous sulfate into sulfur dioxide and iron oxide. Strong gas from the sintering machine is scrubbed and passed through a coke box to make it suitable for use in the contact sulfuric-acid plant. The sintered product is in a good form for charging blast or open-hearth furnaces.

Collection and pumping station

When a pumping or lift station is needed it usually is divided into a wet and dry well. Float controlled pumps in the dry well deliver waste from the wet well to the treating plant. A shredder at the influent of wet well sizes the particles to prevent pump clogging, and assist settling at treating plant



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"Thermodynamic Properties of Chlorine", R. E. Hulme and A. B. Tillman, Chem. Eng. Jan. 1949.

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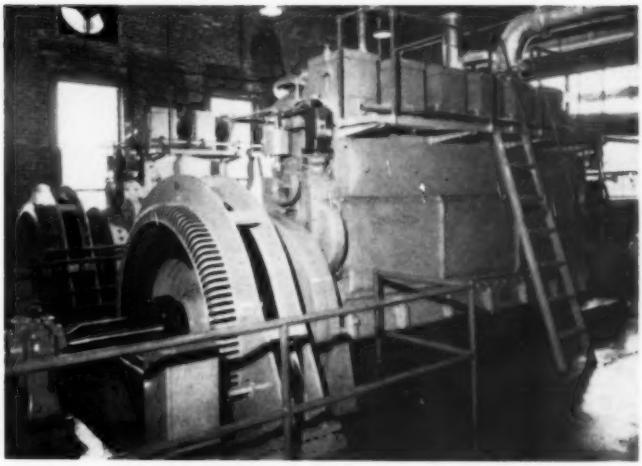
"Metal Recovery by Anion Exchange", F. C. Nachod, U. S. Patent 2,371,119 Mar. 6, 1945.

"Extraction and Recovery of Pectin", P. B. Myers and A. H. Rause, U. S. Patent 2,323,483, July 6, 1943.

"Recovery of Tartrates from Grape Wastes", Marchatt, Fruit Products Jnl Dec. 1943.

These two 550 kw capacity diesel electric units replaced wood waste burning boilers that produced the steam to generate electrical power



- Diesel engines replace boilers fired with wood wastes as power increases required larger quantities to hold loads
- Waste heat from engine exhaust generates kiln steam
- Surplus electrical power sold to the municipality of Laona

DIESEL WASTE HEAT USED IN LUMBER DRYING KILNS

RICHARD M. CONNOR,
President and Resident Manager, The Connor Lumber and Land Co

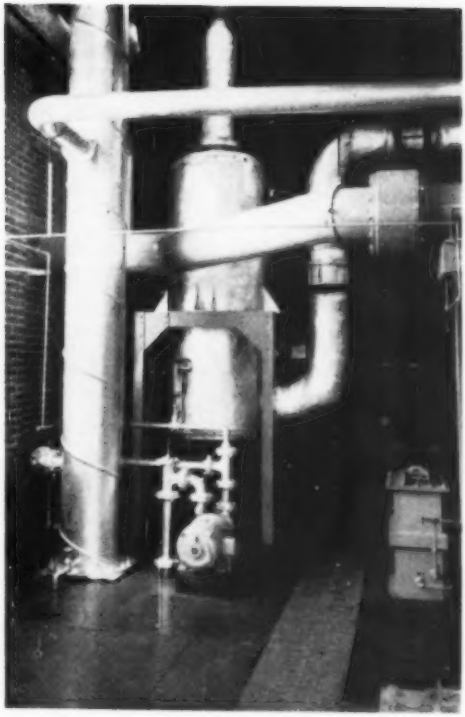
FOR OVER a half century, Connor Lumber and Land Co. has conducted extensive logging and lumber manufacturing operations in Wisconsin. During much of this period power to operate the entire plant and to supply light and power for the town of Laona was obtained by burning wood refuse from various factories. As new uses were found for this refuse, the fuel supply was curtailed to such an extent that it became necessary to supplement sawdust, shavings and hogged wood with considerable coal.

Necessary Expansion

Continual expansion made necessary either the enlargement of the power plant or buying power to operate part of the machinery. After careful consideration and study, the company decided to increase the power house capacity by adding two diesel generator units. Each new diesel is rated at 790 hp when operated at 360 rpm and is coupled to 550 kw generators. Both engines are turbo-charged.

To house these units, a new brick and concrete structure was built adjacent to the original engine and turbine room. This structure, 42 by 56 ft in size, amply takes care of the new units and auxiliaries.

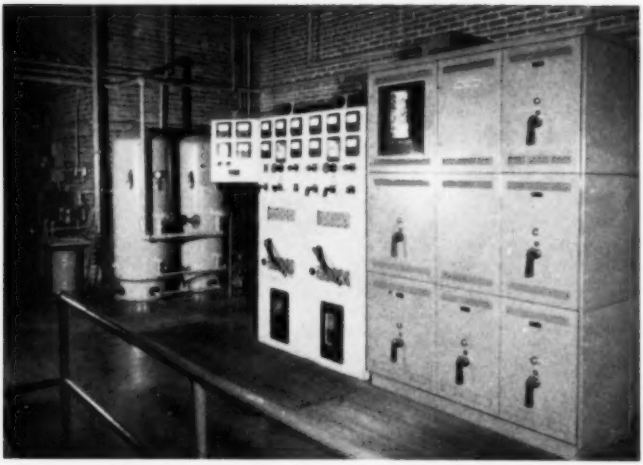
Several unusual features have been incorporated in the plant layout. For



Waste heat recovery unit in background generates steam at 40 psig for industrial processing and wood drying kilns

Jacket water temperatures are regulated automatically. Pump to right of mixing tower maintains full flow of water to engine jackets

Cold boiler water is added on increasing engine load, and excess is bled off at the top of the tower



Switchboard at left controls all diesel operation, while panel at right handles electrical distribution. Starting air storage tanks and compressors are at rear

example, the engine cooling system does not require heat exchangers, as available cooling water is reasonably soft and free from excessive scale forming minerals. Cooling water is circulated by a pump through the engine jacket and into a standpipe. Jacket temperature is maintained at 120 F by controlling water flow by means of a thermostatic valve. Each engine has its own independent cooling system. Excess water flows by gravity from the top of the standpipes to the feedwater heater used in conjunction with the boiler plant. Thus the heat from the engine jackets, as well as from the water, is salvaged.

Waste Heat Boilers

Another arrangement, which is working out very well, is the utilization of waste heat boilers in place of conventional snubbers in the exhaust gas systems. Steam generated by these boilers is piped into a low pressure header and fed to the drying kilns. Amount of steam generated depends entirely upon the load the diesel engines are carrying. Feedwater for the waste heat boilers is obtained from the main boiler supply in the steam plant. Water level is held automatically.

Fuel Storage

Fuel oil storage consists of two 20 and one 12 thousand gal tanks located above ground and accessible by transport truck and railroad. Fuel is pumped into the two 20 thousand gal tanks, through a filter and then to the 12 thousand gal tank. Filtered oil is transferred automatically to the day tanks located in the engine room.

Diesels and part of the distribution are controlled by a cubicle type switchboard coupled to the steam plant by the means of bus duct. All generator cables and other wiring are placed under the floor in transite ducts. Each generator cubicle has an ammeter, power factor meter, wattmeter, watthour meter, voltage regulator and circuit breaker, plus a voltmeter and ammeter for the exciter circuit. The exciter is coupled to the alternator through a motor operated field switch, controlled from the board. A swinging panel contains a synchroscope, frequency meter and voltmeters.

DON'T CLIP—DON'T TEAR
WRITE FOR TEAR SHEETS!

Rather than spoil this issue for other readers in your plant, let us supply you with copies or tear sheets of any of the articles for your files. Just drop a line to the editors—preferably on company letterhead—for articles desired

Starting Air

Starting air is provided by a small air compressor driven by a 5 hp motor. Two 30 by 72 in. air bottles provide storage. Air pressure is maintained at 225 to 250 psi.

To date, the plant has generated 2,914,700 kwh of electricity and has used 212,760 gal of No. 2 fuel oil. This gives an average of better than 13.69 kw per gal. Loading conditions vary from approximately 200 to 600 kw.

Lube oil tanks are placed in a pit near the end of the engines. By-pass filters are employed continually while each unit is in operation. The manufacturer's claim of 4000 hph per gal of oil has been exceeded by about only 10 per cent.

Diesel Operation

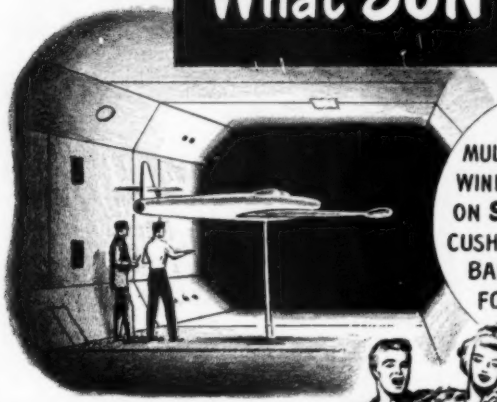
Paralleling the one diesel with the steam generators during the day and operating both at night affords a considerable saving in labor. Previously 552 manhours were required to operate the power plant a week. This has been cut to 432 hours, effecting a saving of about 20 per cent on labor costs.

This diesel plant has been in operation for better than 10 months and to date there have been no unusual operational difficulties and repairs are of no consequence at the present time.

LIST OF PRINCIPAL EQUIPMENT AT CONNOR LUMBER & LAND CO.

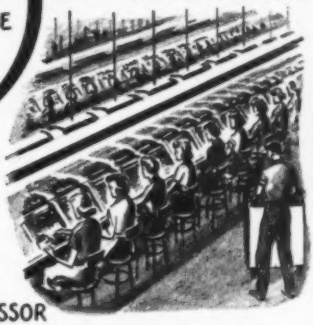
Diesels	Worthington Pump and Machinery Corp.
Generators	Electric Machinery Corp.
Turbo chargers	Elliott Co.
Governors	Woodward Governor Co.
Air filters	Air-Maze Corp.
Waste heat boilers	Sims Co.
Lube oil filters	The Hilliard Corp.
Fuelail filters	The Hilliard Corp.
Oil strainers	Cuno Engineering Corp.
Oil coolers	Ross Heater & Mfg. Co., Inc.
Pumps and compressor	Worthington Pump and Machinery Corp.
Water temperature regulators	Fulton Sylphon Co.
Pyrometers	Alnor Instrument & Pyrometer Co.
Voltage regulators	Westinghouse Electric Corp.
Switchboard instruments	Westinghouse Electric Corp.
Bus duct	Westinghouse Electric Corp.
Distribution switchboard	I-T-E Circuit Breaker Co.
Generator control switchboard	Kehne Electric Co.
Fuel pumps and nozzles	American Bosch Corp.
Feedwater regulators	Northern Equipment Co.

What SUN has done for others...



STRATEGIC MULTI-MILLION-DOLLAR WIND TUNNEL DEPENDS ON **SUNVIS** TO OIL-CUSHION THE SENSITIVE BALANCE SYSTEM FOR MEASURING STRESSES

MANUFACTURER OF BUSINESS MACHINES COATS FACTORY AIR SUPPLY FILTERS WITH **SUNTAC**-IMPROVES PURIFICATION BY 50%



SUNISO IN THE COMPRESSOR ASSURES ICE FOR MAJOR SPORTS ARENA (ONE REFRIGERATION FAILURE COULD COST THE RINK $25,000)

SUN CUP LC GREASE PROVES EFFECTIVE IN MAST AND HOUSING OF TV AERIALS UNDER ALL WEATHER CONDITIONS-AND UNDER TEMPERATURES FROM-20° TO+150°

RIVER TOWBOAT SWITCHES FROM OIL TO **SUN ADHESIVE PRESSURE GREASE** FOR STERN-TUBE BEARINGS. RESULTS: COMPLETE SUCCESS, LONGER LIFE, BIG CUTS IN COSTS

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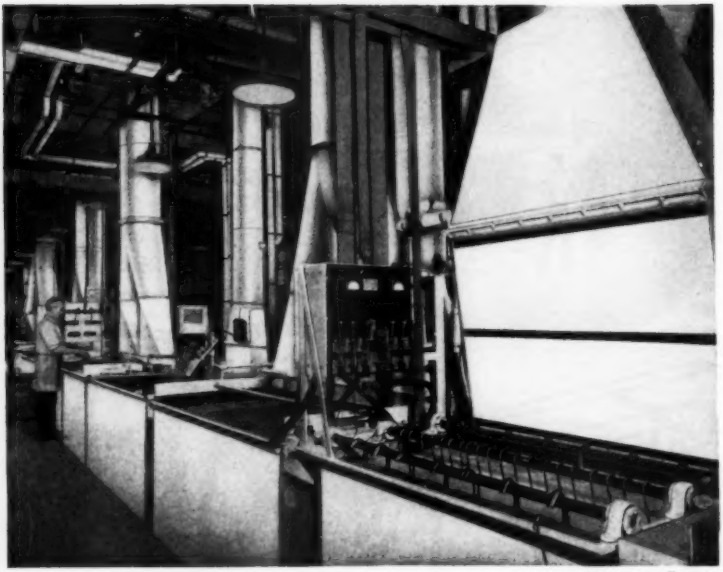
PUTTING *Air* TO WORK FOR

FUME CONTROL

Pipe galvanizing



Plating small parts

Improves Working Conditions
Eliminates Fire Hazards
Lowers Maintenance Costs

Proper fume control can eliminate fire or explosion hazards, improve employee health and morale due to better working conditions, and lower maintenance costs. To help solve *your* fume control problem, Sturtevant has a wide background knowledge based on a variety of applications in many industries.

The systems pictured are equipped with Sturtevant fans to collect inflammable fumes that result from the use of high pressure steam for cleaning or blowout, to carry off injurious vapors where acid baths are required in plating, and to control the unhealthy, corrosive smoke and fumes from melting operations. Whatever the application, Sturtevant can provide fans, exhausters and air handling apparatus to handle fume problems in your plant.

To obtain complete information on your problem, contact your local Sturtevant office or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

YOU CAN BE SURE...IF IT'S **Westinghouse**

PUTTING *Air* TO WORK

J-80201A

PITOT TUBE CALCULATIONS OF AIR FLOW IN DUCTS AND PIPES

JOSEPH T. HOGAN, *Chemical Engineer*

THE NOMOGRAPH greatly facilitates computations when making air-volume calculations for ducts or piping for fans and blowers, and in sizing ducts for air flow in heating and ventilating systems.

Most satisfactory device for measuring air flow in large volumes is the Pitot tube. The velocity in fpm of air in ducts or pipes may be calculated from the velocity-head readings of a calibrated tube by:

$$V = 1096.2\ (h/W)^{1/2} \qquad (1)$$

where:

V is velocity of air, fpm

h is Pitot-tube velocity head, inches of water

W is weight per cu ft of atmosphere at the test conditions of temperature and humidity

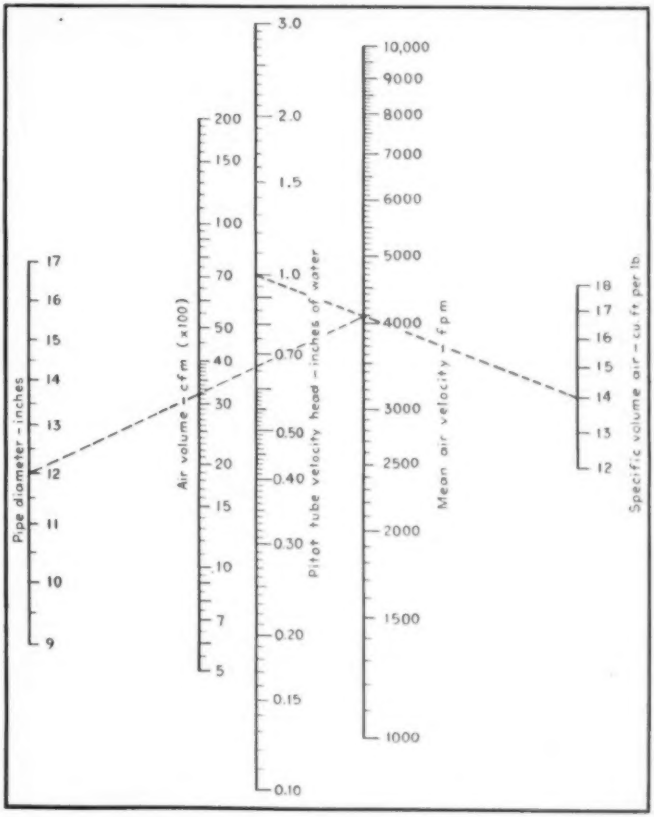
It will be noted that *W* is the weight of one cubic foot of atmosphere at the test conditions of temperature and humidity. Values of *W* may be obtained from tables of the United States Weather Bureau (1). The reciprocal of *W*, that is, 1/W, is the specific volume of the air in cubic feet per pound, and is the quantity employed for use with the nomograph.

Velocity of the air in the duct or pipe as determined by equation 1, multiplied by the cross-sectional area *(A)* of the duct or pipe in square feet yields the volume of air *(Q)* in cubic feet per minute. The nomograph is based on the equation:

$$Q = 1096.2\ A\ (h/W)^{1/2} \qquad (2)$$

For use with the nomograph, the diameter of a circular pipe or duct of cross-sectional area *(A)* is used rather than the quantity *(Q)*.

The ten-point method is used for finding the mean velocity in a circular pipe or duct. This consists of observations with the Pitot tube impact opening set on each of the intersections of a diameter, with the circumferences of the odd numbers of ten concentric circles dividing the cross section into ten equal areas. The inner wall of the duct or pipe is the tenth circle. Since each point of observation controls one-tenth of the cross-sectional area, it is only necessary to add the calculated velocities, and divide by ten to obtain



the mean velocity (2). Use of the nomograph is best illustrated by means of an example.

EXAMPLE: *The Pitot tube velocity head as determined by the ten-point method for a 12-in. duct is 1.0 inches of water. Determine the mean velocity and volume of air. Temperature of the air is 95 F and the relative humidity 10%. Use nomograph to solve.*

SOLUTION: Reference to psychrometric tables shows that air at 95 F and 10% relative humidity weighs 0.0714 pounds per cubic foot. The specific volume (1/0.0714) of the air is 14.0 cubic feet per pound. A straight edge connecting 1.0 on the Pitot Tube Velocity Head Scale and 14 on the Specific Volume Scale intersects the Mean Air Velocity Scale at 4,100 feet per minute. A straight edge connecting 4,100 on the Mean Air Velocity Scale and 12 on the Pipe Diameter Scale intersects the Air Volume Scale at 3,200 cubic feet per minute.

REFERENCES

1. Marvin, C. F., Psychrometric Tables, U.S. Weather Bureau, Pub. No. 235.
2. Marks, L. S., Mechanical Engineers' Handbook, 3rd Edition, pp 2,055, 1930.

HOW TO SIZE VENTILATING OPENINGS

JOHN D. CONSTANCE, ***Professional Engineer***

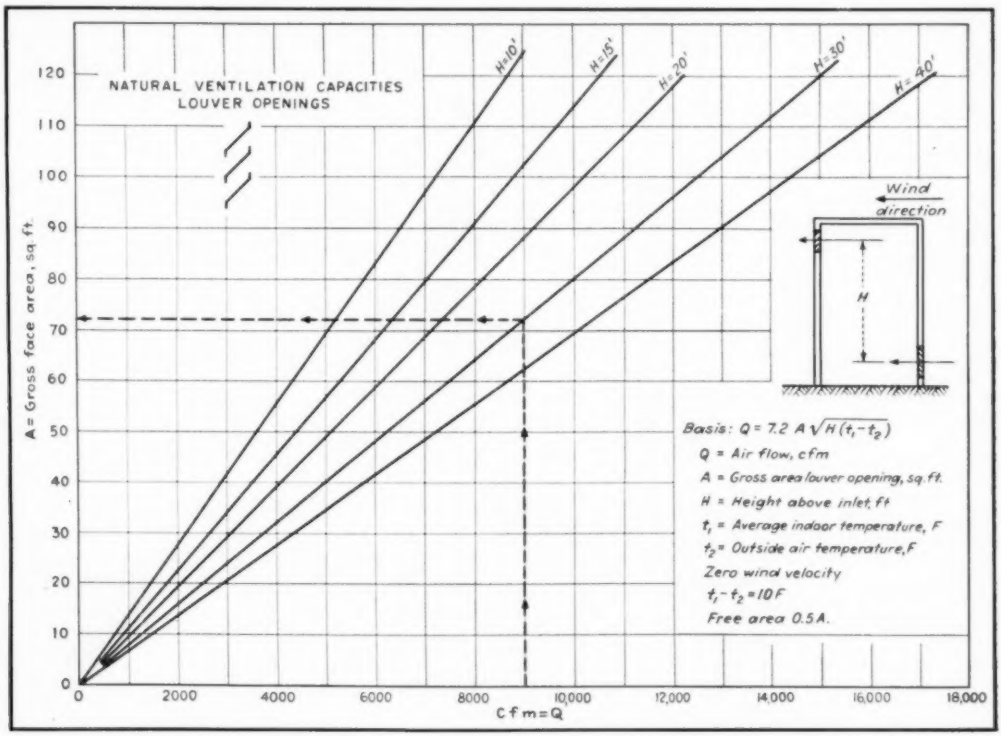
● One of the most important applications of air convection currents is to use them for the natural ventilation of industrial buildings. Using this method, the pertinent factors to consider are temperature difference between inside and outside, and aspirating effect of the wind.

Temperature factors depend on heat produced in the building, the vertical height between inlets and exhaust, and the relative areas of inlet and outlet. Knowing the amount of heat produced in the building, the following equation gives the volume of air to be drawn through the structure:

$$\text{Cfm} = \frac{\text{Heat produced in Btu per hr}}{1.08 \times \text{Temperature difference}}$$

For all practical purposes, the chart helps determine the size of openings. It is based on zero wind velocity and a temperature difference of 10 F. Openings shown are for louver sections. Knowing air quantity needed in cfm and height, the gross area may be found. Inlets should be well distributed on the windward side near the floor.

Put outlets on the lee side near the top. Greatest flow is obtained when using inlet area three to four times outlet area.



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A complete line of proven W&T Chlorinators and Chemical Feed Equipment plus 37 years' experience in the chlorination of water, sewage and other wastes are behind a nationwide staff of specialists able and anxious to assist with your individual problems.
Write to-day to arrange for a visit from your W&T Engineer or for technical bulletins on cyanide waste treatment, all at no obligation.
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WALLACE & TIERNAN
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CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

literature on waste treatment

Listed here and on page 112 are the latest catalogs and literature published by leading manufacturers of industrial waste treatment equipment. Use the postage-free cards on page 117 to order the bulletins you want

700—Clarifiers. The Cyclator, which combines all functions, both chemical and physical, for complete treatment of industrial wastes within a single unit is described in 8-page bulletin 850. Tells what it is; principle of operation; how it works; and recommends general industrial applications. Infilco Inc.

701—Waste Treatment Equipment. Bulletin 833 is a 52-page, comprehensive report on complete line of equipment for treatment of industrial wastes by mechanical means. Offers technical information to aid in selecting equipment and designing plants. Fully illustrated with installation photographs, cutaway views of the equipment, dimension diagrams and flow charts. The Jeffrey Mfg. Co.

702—Clarifiers. Smoothness is the term Infilco uses in 16-page bulletin W-800 describing the operation of its Quiescent clarifiers. Full description of two types—small, and large diameter tanks —is contained along with photos and drawings illustrating features of each. Specifications are included. Infilco Inc.

703—Industrial Waste Equipment. General catalog gives information on equipment specifically designed and engineered for all phases of waste treatment. "Pakage" plant, diffusers, blowers, ejectors and sludge pumps are shown with brief descriptions of the part each play in the system. Chicago Pump Co.

704—Waste Treatment. "Waste Treatment to comply with Stream Pollution Control Regulations" is the self-explanatory title of 8-page booklet 70-A. Contains valuable information for the engineer or executive charged with responsibility for complying with the regulations. Infilco Inc.

705—Consulting Service. Many industrial waste treatment problems are of such nature that solutions usually require the aid of specialists, says 20-page bulletin. Presents an outline of engineering services offered for water and waste treatment problems. Large drawings and diagrams present functional designs of actual treatment plants. W. H. & L. D. Betz.

706—Precipitators. Precipitators offer efficient means for removing impurities from liquids by precipitation, adsorpton, settling and upward filtration, according to 20-page bulletin 2204A. Principles of operation, design, and general advantages are discussed and special applications are listed and described. Tables recommending units for the more common sizes of plants are provided as are 16 paragraphs of specifications. Drawings, large cutaways, diagrams and on-the-job photos illustrate the booklet. The Permutit Co.

707—Waste Treatment Services. Engineering services for all water problems including treatment of waste water are outlined in 12-page booklet. Shows the facilities and personnel available to aid in the solution of your particular problem. Hall Laboratories, Inc.

708—Ion Exchangers. In the treatment of industrial wastes, ion exchangers play an important role. Bulletin 2508 summarizes the properties of ion exchangers and explains the general principles of the system. Diagrams, photos, and cutaways show various types in operation. Engineering service for proper selection of equipment is offered. The Permutit Co.

709—Coagulators. Principal part of H & T's industrial waste water treatment is the coagulator. Bulletin G-1 presents the upflow, slurry type for water clarification. The well-illustrated 16-page booklet gives thorough discussion on general principles, and then shows by diagrammatic layouts how the system performs. Four case histories give "before and after" clarification figures and tell actual operating costs. Several types of chemical feed pumps also are shown. Hungerford & Terry, Inc.

710—Filters. Important part of waste treating systems are filters. Bulletin 23 tells the whole story of the gravity air-water-wash type. Photos, cutaway views and diagrams illustrate the 8-page booklet. Hungerford & Terry, Inc.

711—Filters. Closed, pressure-type water filter is fully described in 16-page bulletin PF. Its operation is illustrated and explained, and the advantages over open gravity types for certain installations are pointed out. Installation photos show the various sizes and models, while charts give dimensions and capacities. Disc and poppet type valves are illustrated and described. Hungerford & Terry, Inc.

712—Reactivators. For clarification of waters containing suspended solids, color and organic impurities by coagulation, Graver recommends its Reactivators. Bulletin WC-103 contains full discussion on principles along with photographs showing the equipment actually at work. Diagram portraying construction and design principles along with chart which explains what happens at every step are included. Typical flow charts show applications in several industries. Graver Water Conditioning Co.

713—Industrial Waste Engineering Service. Bulletin WC-100 is a comprehensive 8-page report on Graver's experience, skill and facilities available to interested parties. Offers chemical analysis, equipment, engineering design, fabrication and construction, erection and installation. Photographs show varied assortment of equipment too numerous to list here. Graver Water Conditioning Co.

714—Hypochlorinators. Small in size; easily installed; requires a minimum of operating supervision—these are some of the qualities listed in 4-page bulletin TP-30 on Hypochlorinators. Four types are illustrated and described. Full details along with specifications are included. Wallace & Tiernan Co. Inc.

715—Chlorinators. Manual or program-controlled chlorinators are presented in 4-page bulletin TP-42. Principle of visible vacuum operation is discussed along with construction and performance features. Wallace & Tiernan Co. Inc.

716—Chlorinator. Function of air-operated visible vacuum chlorinator is to provide safe, dependable and accurate means of controlling the flow of chlorine gas in relatively large volumes, according to Bulletin TP51. Chapters on general description, design and construction, adaptability and control, and operation give all the facts. Includes simplified flow chart along with drawings that show typical layouts and give dimensions of the unit. Engineering data and service information also is contained in the 12-page booklet. Wallace & Tiernan Co. Inc.

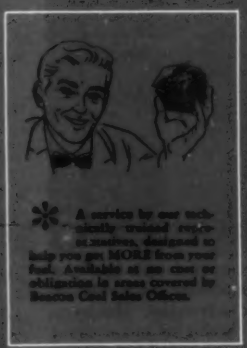
717—Waste Treatment Equipment. Various processes in treatment of industrial wastes are featured in 28-page manual 149. Describes equipment used in the processes and provides photographs and drawings illustrating complete plants and equipment components. Series of treatment processes flow sheets are included. The American Well Works.

718—Liquid Clarification. Complete story on separation of solids from liquids and descriptions of equipment

(Continued on page 112)

is this YOUR problem?

perhaps Beacon Combustion Service* can give you the answer



* A service by our technically trained engineers, designed to help you get MORE from your fuel. Available at no cost or obligation in areas covered by Beacon Coal Sales Offices.

If those "no smoking" signs that municipalities everywhere are hanging on plant chimneys are one of YOUR current headaches . . . maybe the Beacon Combustion Service Man can suggest a cure for you . . . as he has for *many* others.

FOR EXAMPLE . . . A large apartment had a smoke problem. The B.C.S. Man found inadequate firebox combustion space. He recommended pining the stoker, thus doubling the furnace volume. Result: trouble cleared up.

FOR EXAMPLE . . . A textile company was using bituminous coal on a grate designed for anthracite. The B.C.S. Man recommended changing grates, reducing grate area, correcting baffling, and providing for modulated, instead of on-off, draft control. Result: smoke problem solved.

FOR EXAMPLE . . . A manufacturing concern burned oil-and-asphalt impregnated refuse. Black, tarry smoke caused complaints. The B.C.S. Man suggested installation of air jets. Result: smoke reduced to a mere haze.

Perhaps your problem, too, can be solved by a change in operating practice by minor alterations in equipment, or by the addition of auxiliary equipment. If a change in type of coal is indicated, the B.C.S. Man will be happy to recommend the type to fit your exact needs from the comprehensive Beacon line of quality fuels. Just write the nearest Sales Office in the list below.

NOTE TO COAL DEALERS: If any of your commercial or industrial customers or prospects have a problem like this, your B.C.S. Man will be glad to work with you in determining the cause — and recommending a solution.

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NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

Spot News

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants.

Reynolds Building World's Largest Gas-Burning Electric Power Plant

To supply the tremendous electric power requirements in its new $80 million aluminum reduction plant at Corpus Christi, Texas, Reynolds Metals Co. is installing 78 internal-combustion engines totalling 256,300 hp. and driving d-c generators with a total rated output of 176,000 kw. Using natural gas as fuel, it will be the largest gas-burning engine plant so far built.

One section will contain 40 Cooper-Bessemer Type LSV., 16 cylinder, 3700 hp., four-cycle engines, each driving a 2500 kw d-c generator. Total output of this group is 100,000 kw. These engines will be approximately 10 percent more efficient than similar gas engines of a few years ago, since they will employ modern supercharging and air intake cooling.

A second group includes 38 General Motors Model 16-358X 2850 hp., two-cycle engines, each driving a 2000 kw d-c generator for a total output of 76,000 kw.

The power plant will consume approximately a million cu ft of natural gas per hour. Some 45,000 gal. of lubricating oil is required just to fill these engines.

The 176,000 kw developed by this large power plant will permit production of about 17,600 lb. of aluminum per hr., or 422,000 lb. per day, or 150 million lb. per year. Total yearly output of the power plant if operated at full capacity would be well over 1.5 billion kwhr.

Interested in Snow Removal for Next Winter? Data on Radiant-Heat Systems Are Available

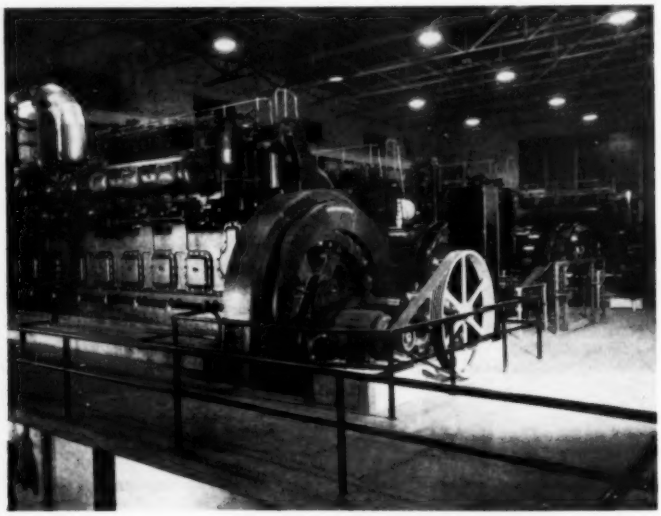
A study of 50 snow melting systems, operating in 15 divisions of business and industry in 17 states, has been made by A. M. Byers Co. Installations covered are in the

Dual Fuel Diesels at La Junta Are Producing Low Cost Power

The La Junta, Colorado, municipal power plant during the past year converted a 1750 hp, 10 cylinder, 16 x 20 in. engine to dual fuel operation and installed a 2000 hp dual fuel Fairbanks, Morse Co., diesel to bring the plant capacity to 6725 hp. Natural gas (900 Btu) reaches the plant at 50 psi and is reduced to 15 psi. It passes through a safety cut-off valve actuated by engine lubricating oil pressure and admits fuel only if the engine is turning over fast enough to bring lube oil pressure to operating level, if pilot oil pressure is adequate to insure combustion and if engine speed is not excessive.

The engines are equipped with standard diesel fuel pumps, which function when they are operated wholly on oil. Pumps cut in automatically to compensate for any gas deficiencies during fuel operation. Pilot oil charge, which initiates combustion, is injected by a separate small volume fuel pump directly to each cylinder. To insure a favorable gas-air ratio, a governor-regulated valve controls the quantity of scavenging air. Gas and air supplies are separate entities and independently controlled. This allows for sufficient combustion air even with gas of low Btu content such as sewage gas.

Separate records are kept of operation, production, fuel and lube consumption, maintenance work and expenditures for each engine. This serves as a guide to intelligent and economical operation. Further, this procedure pays off handsomely in benefits to the plant's collective owners. Records to date indicate that the conversion to dual fuel operation will raise profits and attendent benefits to new heights. *(Courtesy of Fairbanks, Morse Co.)*



In foreground is newly installed dual fuel 2000 hp diesel. At extreme right is the 1750 hp engine converted for dual fuel operation on 900 Btu natural gas

following fields: banks, office buildings, factories, automobile sales and services, highways, commercial establishments, department stores, airports, apartment buildings, hospitals, theaters, hotels, and railroads.

Results of the study have been published in book form which is available free of charge. It contains chapters on design, installation and operation of snow-melting systems; piping properties; use of anti-freeze; paving design and fill; and operating practices, control and costs.

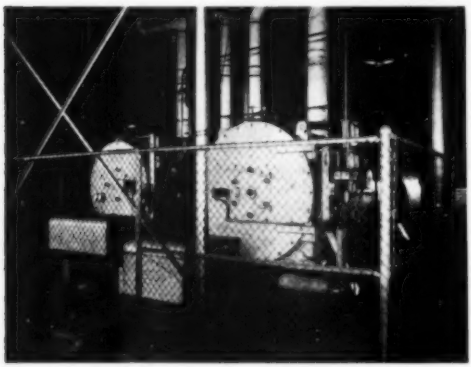
New Jersey Public Service To Get Largest 3600-Rpm Steam Turbine

The Steam Div. of the Westinghouse Electric Corp., South Philadelphia, Pa., has received an order from the Public Service Electric and Gas Co. of New Jersey for a 185,000 kw tandem compound steam turbine, largest single-shaft 3600-rpm turbine ever to be built. The unit will be designed with 25 in. blades, longest ever used, and will be installed at the Burlington, N. J. plant.

The turbine will operate with steam at an initial pressure of 2350 psi and at 1100 F, with reheat to 1050 F, and will be a triple exhaust unit. Tips of the 25 in. blades will travel at approximately 1070 mph when the turbine is in operation. The unit is scheduled for shipment early in 1954.

Packaged Boilers Pay For Selves and Save $10,000 In First Year's Operation

Installation of packaged steam generators has effected great savings by replacing old inefficient boilers in many industrial plants. Take the case of Peoria & Pekin Union



Two York-Shipley automatic packaged steam generators at roundhouse of the Peoria & Pekin Union Railway Company

Railway Co. which purchased two such units: a 75 hp packaged boiler for standby and a 150 hp unit for on-the-line operation. O. T. Carroll, chief engineer, makes the following report on the boilers:

"The operation of the two automatic packaged steam generators installed to furnish steam for heating the roundhouse and offices is beyond expectations as to expense and efficiency. Savings effected in changing from the old coal-fired boiler will pay for the cost of installation and the first year's operation. Cost of the two new generators, fired with bunker C fuel oil, was approximately $35,000. Cost of fuel and maintenance annually was reduced to approximately

this WEINMAN pump is ENGINEERED NOT to clog

Plants that have to handle liquids carrying solids, foreign material and stringy trash get best results from WEINMAN Centrifugal Non-Clog pumps.

These WEINMAN pumps are best for this job because they are created to meet your specific requirements. This WEINMAN non-clog "know how" dates back a good many years. It's the cumulative experience of Centrifugal Specialists who concentrate on only ONE product—PUMPS.

Feel free to tap this experience whenever you have a pumping problem—non-clog or otherwise. The WEINMAN man is ready whenever you are. Just write, wire or phone.

Type U Non-Clog pump is just one of many WEINMAN pumps designed to handle liquids carrying solids.

Representatives in principal cities

Built by Centrifugal Specialists

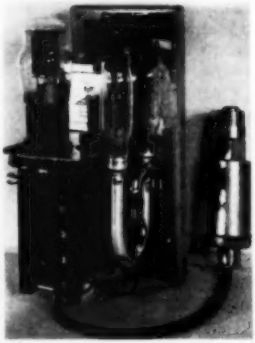
The WEINMAN Pump Mfg. Co.

$8,000—a 66 per cent reduction based on the average operating cost of the old plant of $53,000 per year."

First year cost of these boilers, including purchase price and operation was $35,000 plus $8,000 or $43,000. Since operation and maintenance of the old boiler cost $53,000 annually, the new boilers paid for themselves in the first year and effected a saving of ($53,000 minus $43,000) $10,000. With initial cost written off in the first year, second year's operation will result in a saving of $35,000 plus $10,000 or $45,000.

Supersonic Waves Shatter Boiler Scale In A Newly Developed Application

Boiler scale apparently met its match when Crustex apparatus was installed by the Velan Engineering Co. at a plant of the British Rubber Co., Ltd., Canada. The chief chemist of British Rubber reports that after satisfactory one month tests on an old and new boiler, a 10 week trial was made on a new 180 hp. horizontal return firetube boiler



Supersonic sound waves are generated by this apparatus. During tests by the Canada Rubber Co., it is reported to have loosened scale from tubes, shell and fire sheets of 180 hp. firetube boiler

operating at 125 psig. An average of 20 per cent makeup required 3000 gal. of fresh water per day. No chemicals were used.

When the boiler was inspected at the end of the trial, about 15 lb. of loose scale had collected. The shell was free of mud or sludge. Scale found at various points in the boiler was about 0.020 in. thick, indicating that when it had built up to that thickness, the supersonic sound waves cracked it from the metal.

Offers Handbook On Properties And Working Of Stainless Tubes And Pipe

A complete handbook, "Properties and Methods of Working Seamless and Welded Tubes and Pipe of the B&W Stainless Croloys", is offered by The Babcock & Wilcox Tube Co. Intended for engineers, designers and fabricators, it is designed to serve as a guide in choosing the proper material and as a help in planning the conversion of stainless steel tubing into finished products for industry. The 104-page leather-bound booklet is 5x8 in., a handy size for desk or pocket.

It deals with methods of manufacture and inspection, corrosion and oxidation resistance, and methods of working and fabrication, all liberally illustrated with photographs, detailed diagrams, and useful charts. Tables of technical

(Continued on page 152)

WHEN THE PRESSURE OF INDUSTRY IS GREAT...COUNT ON CHATILLON FOR UNFAILING AID!

Since 1835, John Chatillon & Sons have been world famous for the precision manufacture of force measuring devices which meet the most specific requirements of industry.

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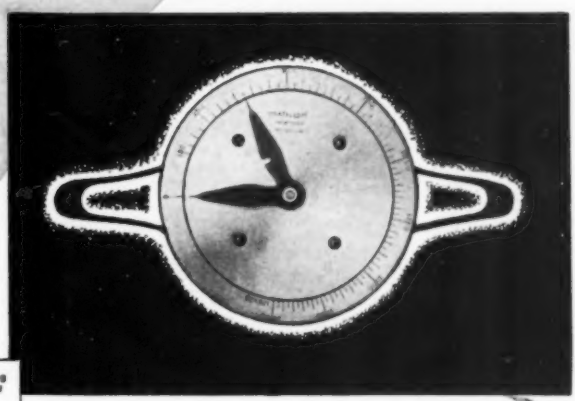
- For determining sag in stringing transmission lines.
- To ascertain force required to pull underground cables and wires through conduits.
- For guy wire tensions, pole, insulator and anchor strength.
- For use in conjunction with apparatus that apply force to test strength of materials and structures.
- Gear Mechanism is Enclosed in Dustproof housing.
- Accuracy is Guaranteed to within 2% plus or minus of dial reading.



Traction Dynamometers are made in Capacities shown below:

Capacity & Graduations in lbs.	First Dial Reading lbs.	Dial Dia. Inches	Shipping Weight lbs
1000 x 10	100	7	8
2000 x 25	150	7	9
5000 x 50	250	8	9
10000 x 100	500	10	15
25000 x 200	600	14	45
50000 x 250	1000	16	56
100000 x 500	1000	18	95

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Manufacturers of Precision Instruments Since 1835

WASTE TREATMENT LITERATURE

(Continued from page 106)

available to accomplish the separation are contained in 36-page bulletin 48-41. Chapters on hydraulic separation, grit chambers, grit washers, thickening, sludge collectors and removers, skimmers, screens, grinders, and a full section on liquid clarification are given. Diagrams and flow charts are included. Of particular interest is conversion factors table for units of measurement. Chain Belt Co.

719—Centrifugal Pumps. For waste disposal there are Mixflow pumps in sizes from 10 to 84 in. with special type impellers to permit the passage of large solids. Bulletin W-313-B1B, 4 pages, gives all the details, including line drawings and dimensions of various units. Worthington Pump and Machinery Corp.

720—Sludge Pumps. For handling heavy, troublesome wastes, Marlow has "the answer"—plunger sludge pumps, which are described and illustrated in 4-page bulletin S-48. Cutaway views show construction details and points out important features. Sizes and models are illustrated and briefly described. Marlow Pumps.

721—Centrifugal Pumps. Bulletin IB-49. 12 pages, presents self-priming centrifugal pumps in a wide range of models and sizes, applicable to handling liquids with suspended solids. Shows construction, gives specifications, engineering and installation information, along with performance tables. Marlow Pumps.

722—Centrifugal Pumps. Non-clogging pumps, designed specifically for handling liquids carrying large solids, are the subject of 12-page bulletin 730-C. Cutaway views show construction details of horizontal and vertical types along with drawings giving roughing-in dimensions. General specifications are included as is capacity, head and speed table. Photographs show typical installations of various units. The Weinman Pump Manufacturing Co.

723—Evaporators. Evaporators may be used in some industrial waste treatment processes. Bulletin 366, 26 pages, thoroughly covers the subject of evaporators. Construction features and operating advantages are explained pictorially and descriptively. The Griscom-Russell Co.

724—Flotation Units. Method of waste solids removal from liquids is explained in 4-page bulletin A690 on fully automatic flotation units. Cutaway shows components, and photo illustrates rotor-stator assembly. U. S. Hoffman Machinery Corp.

725—Agitation & Blowing. Turbo-compressors offer reliable operating characteristics and steady air pressures with high efficiencies and low maintenance costs, according to 4-page bulletin 142. List of features, maintenance hints, and data required for recommendations are contained as are photos and drawings showing various applications. The Spencer Turbine Co.

726—Filters. Filters fill the need to remove solids from waste fluids before discharging. You'll read all about edge type filters in 4-page bulletin that refers you to specification sheets for detailed information on sizes and capacities. The Cuno Engineering Co.

727—Filters. The story of Flo-Clean, self-cleaning filter. Discusses construction and design advantages along with facts and figures on proven performances. Engineering information together with design data and flow tables are included in the 12-page bulletin. The Cuno Engineering Co.

728—Underdrain System. Bulletin 5128, 4 pages, gives particulars on baffle plate type of underdrain system for purifying water. Said to be non-clogging and to provide even back-wash distribution. Cutaway views show just how the system works. General Filter Co.

729—Water Treatment. Equipment used in treatment and conditioning of water is presented in 8-page general bulletin 5104. Pictures and captions show the diversified line, while the function of the organization is given descriptively. General Filter Co.

730—Filters. Catalog 49 tells the story of plate and frame filtration. Describes the principle and operation of filter presses and provides data on the costs and selection of the proper type and size of filter press. Application data included. T. Shriver & Co., Inc.

731—Slurry Thickener. Complete details on equipment which thickens slurries is contained in bulletin 122. Shows how the cost of thickening materials, which involve corrosive conditions, is reduced. T. Shriver & Co., Inc.

732 Floating Roof Tanks. Three types of floating roof tanks are illustrated and detailed in 8-page bulletin 51F. The advantages and features of each—double deck, pontoon, and pan floating,—are shown pictorially and are discussed thoroughly. Hammond Iron Works.

733—Specialties. Valves, flanges, hose nipples, etc., made of Worthite—corrosion-resistant metal—are pictured and described in 6-page bulletin. Bolted bonnet, O. S. & Y. gate valve is standard model and comes in ½ to 12 in. sizes. Contains diagrams and instructions that make it easy to reseat valves. Worthington Pump & Machinery Corp.

734—Plastic Pipe & Fittings. Complete engineering data on chemical resistant tubing, pipe, valves and fittings are given in 16-page bulletin. Includes tables of properties and tables of resistance to common chemicals. Gives bursting and working pressures, sizes and weights. American Hard Rubber Co.

735—Waste Structures. Corrugated metal structures are discussed in 4-page folder CMS15050. Describes applications and lists inspection reports on structures used in the industrial field. Points out ease of installation and offers means of repairing. Armco Drainage & Metal Products, Inc.

736—Piping. Facilities for fabrication and erection of industrial piping are illustrated and described in 24-page bulletin 1700. Numerous photographs show piping installations across the industrial field. Engineering services also are described. Dravo Corp.

737—Clarifiers. Circular clarifiers, digesters, rectangular clarifiers and other equipment for industrial waste treatment are presented in 12-page bulletin 35-C. Cross section drawings are used to illustrate various units. Full description along with general specifications for each type are given. Lists typical installations in addition to showing on-the-job photographs. Hardinge Co., Inc.

738—Valves. Though cast iron is standard construction, Rockwell valves can be made of materials to meet any conditions of corrosion, abrasion and temperature. Catalogs listed below contain the usual photos, diagrams, and dimensions tables along with discussions on construction, features, pressures, applications and instructions for ordering. Bulletin 500 deals with **slide valves;** shows four types of operating control—pull handle, lever control, hand wheel control and chain wheel control. 8 pages.

739—Butterfly Valves. Bulletin 502 covers flanged butterfly valves; shows four types of control.

740—Wafer Butterfly Valves. Light but sturdy construction features are stressed in bulletin 503R.

741—Threaded Butterfly Valves. Threaded type which fits into any system is described in bulletin 504.

742—Motorized Valves. Bulletin 505 RX shows a number of automatic control mechanisms which can be applied to valves. Automatic operation by electricity, air, water or oil can be furnished. W. S. Rockwell Co.

743—Clarifiers. High-rate, sludge blanket type of unit is thoroughly covered in 24-page bulletin 9041. Fundamental principles, action of unit, distinguishing characteristics, fields of application, advantages, capacity ratings, typical operating data, suggested specifications, and other useful information are presented. Types and sizes along with cutaway diagrams showing the units are given. The Dorr Co.

TECHNICAL PAPERS

744—"Disposal of Cyanide Solutions." E. F. Houghton & Co.

745—"Approaching an Industrial Waste Problem." 746—"Tissue Paper Wastes Treated by Saveall Closed System." 747—"Chlorine Treatment of Cyanide Wastes." 748—"Industrial Waste Pollution Must Be Eliminated." 749—"Four Ways to economize on Industrial Wastes." Gilbert Associates, Inc.

Now-Automatic Lubrication System

SPEEDS...SIMPLIFIES...CUTS COST OF MACHINERY LUBRICATION!

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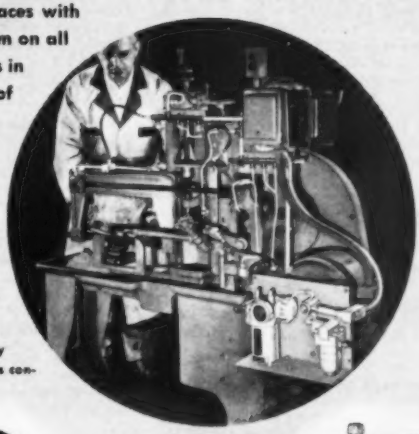
OIL-MIST

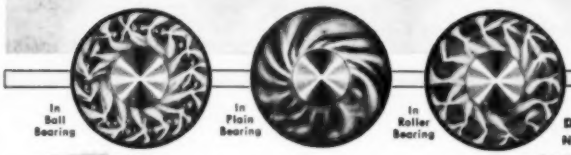
AUTOMATIC LUBRICATION SYSTEM

Unbelievably simple system atomizes oil into mist, distributes it through tubing to bearings. Bathes all bearing surfaces with fresh, clean, cool oil film. Uniformly maintains oil film on all sliding, rubbing, rolling parts regardless of variations in load, temperature or speed. No "peaks and valleys" of lubrication.

Fully automatic—eliminates waste and the uncertainties of the "human element." Extends bearing life as much as 17½ times. Seals bearings against dirt and abrasives. Cuts oil consumption as much as 90%. Greatly reduces the number of oils needed.



Eleven points on this automatic electric saw are served by Oil-Mist. Flexible lines carry lubricant to reciprocating and oscillating parts . . . condensing fittings apply liquid oil to a cam and roller . . . a spray fitting sprays oil on a drive chain, gear and sprocket. The lubricator is controlled automatically by the machine switch.



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readers' guide to advertised products

Here you'll find, briefly reviewed, all the booklets and leaflets offered in the advertising columns of this issue of INDUSTRY AND POWER. For easy reference, this listing is divided into various classifications of products. To get your free copies of literature described here and in the corresponding advertisements, turn to Page 117 for a postage-free order card. There, list the key numbers of the paragraphs below and mail.

AIR & DUST FILTERS & COLLECTORS

500—See page 123. Dust & Fume Control Systems: Kirk & Blum experts can design and install a complete dust or fume control system for your plant that will solve your problems. Write for booklet with information. Kirk and Blum Mfg. Company.

501—See page 102. Fume Control: Write for complete information on Sturtevant fans, exhausters and air handling apparatus to help solve your fume control problem. Improves working conditions, eliminates fire hazards and lowers maintenance costs. Westinghouse Electric Corporation, Sturtevant Division.

ANTI-CORROSIVE & PROTECTIVE COATINGS

502—See page 45. Rust Preventive: Rust-Oleum seals metal so that no rust-causing oxygen can reach it. Available in a full range of colors. Write for complete literature. Rust-Oleum Corporation.

503—See page 121. Corrosives Handling Equipment: Send coupon for the following bulletins on corrosives handling equipment: Bulletin 703A on Duriron Drain Pipe; Bulletin V4/647 on Durco Type F Plug Valve; Bulletin P4 on Model 40 Series R Standard Durcopump; and Bulletin M5/1103 on Durco Exhaust Fans. The Duriron Company, Inc.

504—See page 144. Corrosion Proof Materials for Industrial Waste Problems: The following bulletins are available upon request: Bulletin 5-1 on Corrosion Proof Cement; Bulletin 2-30A on Atlas Acid-Alkali Solvent Proof Sewer Joints; and Bulletin 7-1 on Protective Coatings. Write for your copies today. Atlas Mineral Products Company.

BOILERS & BOILER ACCESSORIES

505—See page 138. Boiler Blowdown Equipment: Write for complete details on this compact, self-contained unit that provides fully automatic control of boiler water concentration without heat loss. Prevents priming, foaming, sludge, scale. Henszey Company.

506—See page 144. Firebox Type Boilers: Especially adapted for high pressure—10 to 304 hp, 100, 125, 150 lb wp. Send for full information and free 6 in. scale with pipe diameter markings. Kewanee Boiler Corp.

507—See page 159. Steam Generators: Wickes can fill your exact requirements for boilers of any type up to 250,000 lbs. steam per hour and 950 psi. Write for descriptive literature on the famous Wickes line of steam generators. The Wickes Boiler Co.

508—See pages 8, 9. Steam Generating Units: Select Riley equipment for efficient, trouble-free performance that cuts operating costs to minimum. Write today for further information. Riley Stoker Corporation.

BUILDING HEATING, VENTILATING & AIR CONDITIONING & REFRIGERATION

509—See page 58. Trane Equipment: Whatever your factory heating, ventilating, cooling or air conditioning problem is, look first in the answer in the Trane line. An inquiry will bring you complete data on equipment engineered for your particular job without obligation. The Trane Company.

BUILDING MATERIALS & MAINTENANCE

510—See page 142. Free Repair Handbook: 40 pages describing Smooth-On repairs that can save you time and money. 170 illustrations. Write for your free copy now. Smooth-On Mfg. Co.

511—See page 151. Instant-Use Floor Patch: Tough, plastic material which restores broken concrete to solid smoothness. Run traffic over it immediately. Write for details of free trial offer and "Hand Book of Building Maintenance." Flexrock Co.

512—See page 148. Pipe Joint Sealing Compounds: Pipe joints and fittings sealed with Key sealing compounds do not leak. Connections will not freeze and reopening is easy. Send for free sample. Key Company.

CINDER & FLY ASH EQUIPMENT

513—See page 63. Fly-Ash Collector: Buell van Tongeran Cyclones can help you do a real job of fly-ash collection on pulverized coal-fired boilers. If you have a serious fly-ash problem, an inquiry will bring help in a hurry. Buell Engineering Company.

COAL, ASH & BULK HANDLING

514—See page 3. Conveyer Belts: Call your nearest Goodyear Technical Man or write today for help in selecting the belt that will handle more coal for longer periods at less cost. Goodyear Tire & Rubber Co.

515—See page 62. Materials Handling Systems: Let Jeffrey engineers give you cost cutting solutions to your materials handling problems. Complete line of material handling, processing and mining equipment. Write for full details. The Jeffrey Manufacturing Company.

COMPRESSORS

516—See page 55. Rotary Compressors: Send for Bulletin C-5. Packed with detailed information on these quality compressors—designed and built to give a life-time of new machine service. Write today. Fuller Company.

517—See page 158. Compressors: Write for Bulletin 726 covering these duplex synchronous motor-driven compressors in sizes from 500 to 12,000 c.f.m., piston displacement at 100 lbs. pressure. Chicago Pneumatic Tool Company.

518—See page 43. "Vibrationless" Air Compressors: Schramm stationary air compressors are so free from vibration they can be operated without elaborate foundation by simple grouting and bolting to floor. Sizes 1/3 to 100 hp. Write for free Bulletin C-50B with complete information. Schramm, Inc.

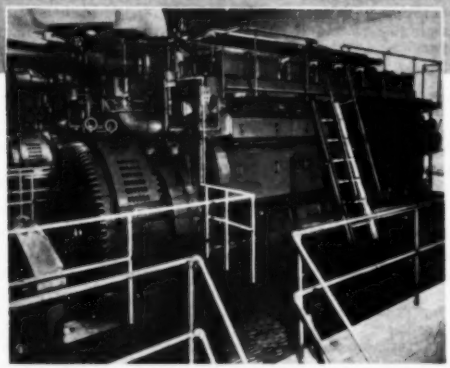
CONTROLS, REGULATORS & INSTRUMENTS

519—See page 142. CO_2 Indicator: You can check for carbon in flue gas in only 40 seconds with this easy-to-use indicator. Write for Leaflet 795 for full details. Bulletin 700 describes instrument for direct oxygen analysis. Also avail-

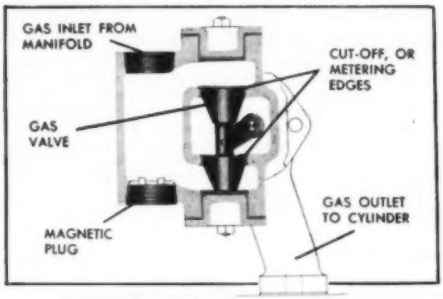
(Continued on page 117)

They're Handling Expanding Power Loads The Fast, Low Cost Way:

Iowa Utility Company, Like So Many Others, Uses Worthington Dual Fuel Units For Uninterrupted Service On The Cheapest Fuel Available



A Worthington Supercharged Dual Fuel Engine in the Oskaloosa plant — part of the Iowa Power And Light Company System.



WORTHINGTON MICRO-METERING GAS VALVE
One for each cylinder

Used on Spark Ignition and Dual Fuel Engines — Governor controlled — Individually adjusted.

Assures: — Equal cylinder loading — Smooth running at all loads — Better speed regulation — Lower maintenance.

Full load operation, 24 hours a day, is routine performance for Worthington Dual Fuel Engines. They're designed and built to do just that — and they're doing it for power companies in communities all over the world.

They're saving money for their users every day, too, because of their Worthington-pioneered dual fuel feature that enables them to operate on gas or oil, or any combination of these fuels. Also, without losing load, they can instantly be changed over from one fuel to the other.

When gas is your fuel, only a very small amount of pilot oil is needed for ignition. Micro-metering valve (see drawing) on each cylinder provides equal distribution of gas for smooth, steady operation. Supercharging assures maximum economy through high thermal efficiency with either fuel.

BESIDES FUEL SAVINGS—

Lubrication and maintenance costs have been cut to a minimum through an effective system of "hot-spot" lubrication, according to users of Worthington Dual Fuel Engines. Why not get the whole story that proves *there's more worth in Worthington?* Write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.*

WORTHINGTON

E1-2

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Diesel engines, 150 to 3,520 hp . . . gas engines, 175 to 3,520 hp . . . dual fuel engines, 225 to 3,290 hp.

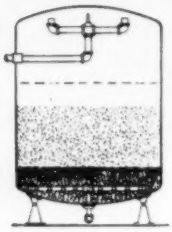
Balanced Angle Compressors

Oil Transfer Pumps

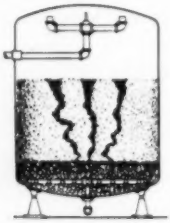
Cooling Water Circulating Pumps

Evaporative Type Engine Water Cooler

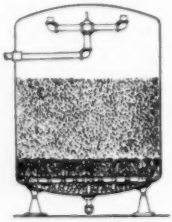
Is your water softener operating in the HIGH COST zone?



Check for zeolite loss



Check for packed and channelled zeolite



Check for worn out zeolite

Here's an easy way to find out

Far too many zeolite water softeners in use today are operating in the high cost zone—without it being known. How about your softener? Is it delivering less soft water than it did when new? Does it require more frequent regeneration with greater salt consumption? If so, it is operating in the high cost zone and you are not getting full value from your investment.

LOSS OF ZEOLITE can cause a big drop in soft water output.

PACKING AND CHANNELING will greatly reduce water softening capacity, cause hard water to leak through the softener and damage the zeolite.

WORN OUT OR DAMAGED ZEOLITE can also cause a big reduction in soft water gallonage.

Any of these troubles necessitate more frequent regeneration with greater salt consumption.

How to make your water softener perform like new

Any lost zeolite should be replaced with new at once. Damaged or worn out zeolite should be completely replaced. Packing and channeling can be remedied by loosening up the zeolite and providing the backwash rate required to properly cleanse and agitate the zeolite so that packing will not recur.

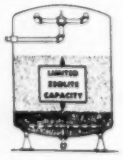
Your Elgin representative will be glad to check your softener and show you how to make it perform like new. With all types of zeolite to choose from, he can provide the kind you need. Whatever the type, you may be sure it will give maximum capacity and years of efficient service.

How to make it deliver up to 10 times more soft water

If your softener uses one of the older type zeolites of low softening capacity, you can switch to one of the amazing new Elgin high capacity types. In this way, it may be possible to get as much as 10 times more soft water from your softener. But even if the zeolite in your softener is entirely satisfactory, we can increase its capacity as much as 44% and prevent future costly zeolite loss. The ingenious Elgin Double Check type manifold, adaptable to any make of water softener, makes this possible. It permits the use of a deeper zeolite bed in your present softener which provides the added softening capacity as diagrammed below. Your Elgin representative can show you how this manifold arrangement can be installed at low cost in your water softener.

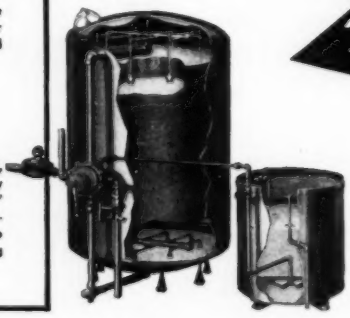
ELGIN SOFTENER CORPORATION, N. Grove Avenue, Elgin, Illinois

WRITE US TODAY for full particulars



Shallow zeolite bed of ordinary water softener gives limited softening capacity.

Deep zeolite bed, made possible by Elgin "Double Check" Manifold arrangement, gives up to 44% more softening capacity.



ELGIN
Economical WATER CONDITIONING FOR EVERY NEED
Since 1908

ELGIN WATER SOFTENER

Gives Up to 44% More Soft Water

Where new equipment is required, the advanced Elgin "Double Check" Water Softener is your best buy. Compared with others it delivers up to 44% more soft water; prevents costly zeolite loss; costs less to buy and operate. Ask for Bulletin 610.

readers' guide to advertised products

(Continued from page 114)

able upon request. Bacharach Industrial Instrument Co.

520—See page 38. Temperature Control: Spence Temperature Regulators reduce the steam pressure and also accurately modulate flow as required to control temperature. For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200. Spence Engineering Co., Inc.

521—See page 148. Temperature Regulators: Write for Stacon Bulletin 50-1000 for full details on extra sensitive, accurate, economical temperature regulators. Farris Stacon Corporation.

522—See page 148. Automatic Liquid Measuring Gages: Write for complete details on liquid level gages for measuring liquids of all kinds. Dial readings in feet, inches, gallons, pounds or any desired units. The Liquidometer Corp.

523—See page 151. Automatic Controls: Write for catalog with information on this complete line of automatic controls for heating, air conditioning, refrigeration and various industrial applications. Mercoid Corp.

524—See page 137. Pressure Regulators: Write for complete data on Mason-Neilan No. 515 and No. 11 pressure regulators. Ruggedly constructed for long operating life. Mason-Neilan Regulator Co.

525—See page 139. All-Metal Thermometers: Write for complete data on these easy-to-read ruggedly constructed thermometers for most industrial applications. Wide variety of types. Literature also describes electrical and glass thermometers. Weston Electrical Instrument Corporation.

526—See page 136. How To Reduce Thermocouple Cost: For complete information on either repairs and reclaiming or new couples, fill out coupon on page 136 and mail today. If you prefer, use this item number on the Reader Service Card to obtain free copy of Engelhard Bulletin 330-D. Charles Engelhard, Inc.

527—See page 150. Hopper Level Switches: Syntron Hopper Level Switches maintain the right amount of material in bins and hoppers. Write for complete data. Syntron Co.

528—See page 157. pH Indicators and Recorders: Send for descriptive literature and photographs of pH indicators and recorders for the control of alkalinity and acidity factors. Dependable, ruggedly built, and simple to operate. Cambridge Instrument Co., Inc.

529—See page 111. Measuring Devices: You can obtain complete information in brochures describing force measuring devices, push pull gauges, traction dynamometers and laboratory scales by checking the brochure you need on the special coupon to be found on page 111. John Chatillon & Sons.

530—See page 140. Temperature Indicating Regulators: Combine the advantages of easy-to-read dial thermometer with dependable, self-operating regulator. Easy to install. Write for Bull 328. The Powers Regulator Co.

531—See page 148. Portable Gas Analyzer: Write for Bulletin 120 describing Ellison Portable Gas Analyzer. Gives complete story of flue gas content. Accurate readings for CO_2, O_2 and CO-plus a flue gas thermometer. Write today. Ellison Draft Gage Co.

DIESELS

532—See page 40. Diesel Engines: If you're looking for reliability and long life in your diesel engines, then you should have complete information on Cooper-Bessemer — dragline, marine, stationary, locomotive, or any other heavy-duty power application. Mail your inquiry today for full facts. The Cooper-Bessemer Corporation.

ELECTRICAL DISTRIBUTION

533—See page 151. Fuses and Clamps: Write for Bulletins No. 7 and 6 describing "Kliplok" clamps that eliminate damage to electrical equipment and shutdowns. Trico Fuse Mfg. Co.

534—See page 65. Sealtite Flexible Conduit: The ideal flexible electrical conduit for wiring on machines, motors, controls, etc.; for protecting wiring against water, oil, grease chemicals or abrasion. Write for Bulletin C-188 with complete details. America Metal Hose Branch, The American Brass Company.

536—See pages 14, 15. Mechanical Rectifiers: Write for full details on widely used I-T-E mechanical rectifiers that give you higher efficiency, space savings, low cost installation and maintenance, simple operation and safety. Available in ratings from 4,000 to 10,000 amps. I-T-E Circuit Breaker Co.

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers of the paragraphs describing the items you want in the spaces provided on cards below.

To: INDUSTRY AND POWER, St. Joseph, Michigan **June, 1951**

Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

Inquiries for items listed in this issue not serviced beyond Oct. 1, 1951

Advertised Products Numbers begins Page 114	*New Equipment Numbers begins Page 10*	*New Bulletin Numbers begins Page 26*

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

2¢—POSTAGE WILL BE PAID BY

INDUSTRY and POWER
420 MAIN STREET
ST. JOSEPH, MICH.

537—See page 66. Hook-On Power-Factor Meter: With the new AK-3 hook-on power-factor meter you can read power factor quickly and accurately. List price of AK-3 is $84.75. Write for Bulletin GEA-5469 with complete data. Bulletin GEA-2742 describes Pyranol Capacitors that save money, increase circuit capacity and improve power factor. General Electric Co.

538—See page 141. Magnetic Starters: Write today for free booklet on Arrow-Hart "RA" magnetic starters. High arc resistance, ease of wire and servicing, balanced mechanism cuts space. The Arrow-Hart & Hegeman Electric Co.

STEAM ENGINES

539—See page 22. Steam Engines: Cut your power costs by putting steam fully to work. Use exhaust from the Troy-Engberg Steam Engine for your processing or heating, or both. Send for your copy of Bulletin 306. Troy Engine & Machine Co.

FANS & BLOWERS

540—See page 41. Blowers: Check and mail coupon on page 41 for full information on how Coppus blowers or exhausters supply fresh air to men working, and step up production. Coppus Engineering Corporation.

541—See page 154. Multistage Centrifugal Blowers: Write for Free Bulletin A-650 with details on Hoffman multistage centrifugal blowers. Built for heavy-duty, continuous service. Models for wide range of pressures and volume, for air or gas. Bulletins also available on portable and stationary vacuum cleaning equipment. U. S. Hoffman Machinery Corporation.

542—See page 2. Vaneaxial Blower: If you've got a job of moving air against heavy pressure, be sure to check the new low prices on the Hartzell Vaneaxial Blower. Mail coupon for complete data. Hartzell Propeller Fan Co.

543—See page 121. Exhaust Fans: Send coupon on page 121 for Bulletin M5/1103 on Durco exhaust fans. Resists corrosion. Available in Duriron and Durichlor in various drives, sizes and capacities. Write today. The Duriron Company, Inc.

FILTERS, STRAINERS & PURIFIERS

544—See page 60. Scraper Strainers: Available in sizes from ¾ to 8", up to 200 lbs pressure, hand or motor operated. Bodies, screens and rotors can be made of any metal needed for application. Ask for Catalog No. 1225. Sarco Company, Inc.

545—See page 129. Filtration Equipment: Hoffman flotation unit minimizes disposal problems, saves soluble, cutting and hydraulic oils—industrial water. Capacities from 20 to 1000 gpm. Write for Technical Bulletin A-690. U. S. Hoffman Machinery Corporation.

FUELS & FIRING EQUIPMENT

546—See page 23. Detroit Stokers: Write today for full information on Detroit Stoker's complete line—Lokostokers, Unistokers, Double Retort, Rotostokers, and Rotograte stokers. Detroit Stoker Company.

547—See page 153. Fuel Oil Additive: Houghto-Solv dissolves all the sludge in your entire system—cleans tanks, lines, strainers, pumps, nozzles, etc. Write for sample with full information and prices. E. F. Houghton & Co.

548—See page 37. Gas and Oil Burners: This company manufactures burners for every heating and power need—combination gas and oil burners, for either vertical or horizontal firing. Write for free literature. John Zink Co.

549—See page 4. Turbo-Aire Over-Fire Air Systems: Turbo-Aire insures maximum combustion of fuel used with more heat per pound of fuel burned, elimination of smoke and soot, and cleaner flues and stacks. Send coupon for bulletin with complete information. Turbo-Aire Division, Canton Stoker Corp.

550—See page 107. Coal: If you have a coal problem, consult the Beacon Coal Sales Man for the type to fit your exact needs from the Beacon line of quality fuels. Eastern Gas and Fuel Associates.

HEAT EXCHANGER EQUIPMENT

551—See page 50. Film Type Exchangers: Bulletin HE-7 describes typical installations of Vogt Film Type Exchangers that operate with economy. Serve as jacket water coolers, feed water heaters, hydrocarbon evaporators, sulphuric acid coolers, and sulphur dioxide condensers. Can be designed to cool or heat any liquid and to condense or evaporate any fluid. Write today. Henry Vogt Machine Co.

552—See page 133. Instantaneous Water Heaters: Engineered for all industrial needs. Provides hot water instantly at the temperature required in the volume needed. Write for complete engineering details and specifications. Pick Mfg. Co.

(Continued on page 120)

Use these postage-free cards to order booklets and catalogs from advertisers, new bulletins and new equipment literature. List key numbers of the paragraphs describing the items you want in the spaces provided on cards below.

FIRST CLASS
PERMIT No. 19
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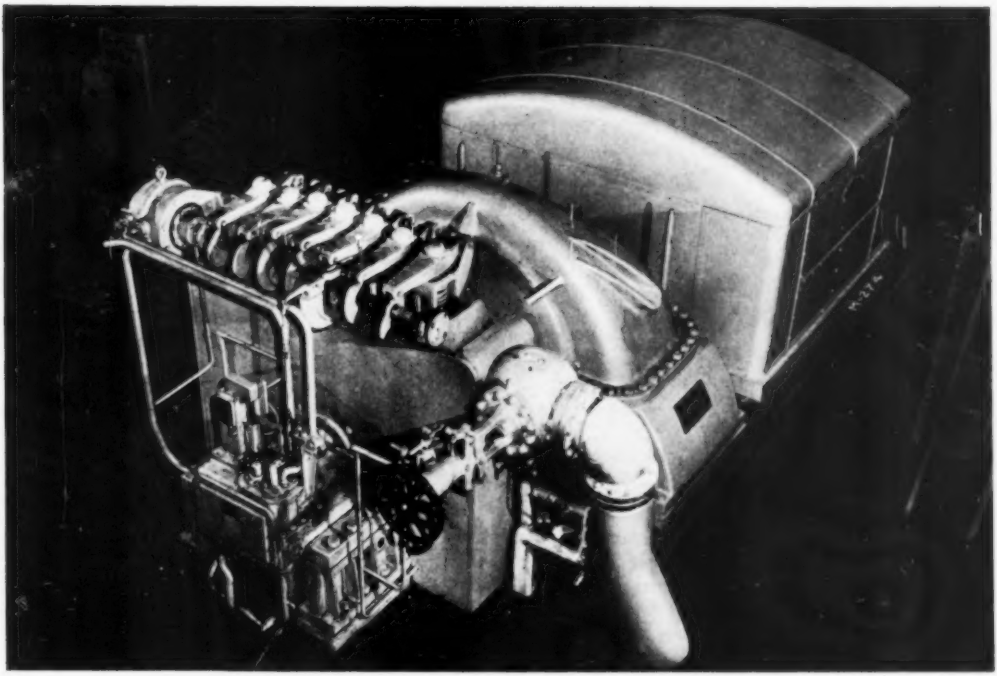


Side-Mounted Coolers

simplify turbine installation

This 5000 kw Worthington turbine generator was installed several years ago by a midwest cement producer.

The generator is equipped with split, side-mounted air coolers. This arrangement is desirable where it is necessary to save basement space below the unit. These coolers are readily accessible, and each can be cleaned while the unit is in operation.

Selection of a Worthington turbine generator gives *unit responsibility* for design, assembly and performance. All Worthington turbines and generators are tested *together* as a unit before shipment.

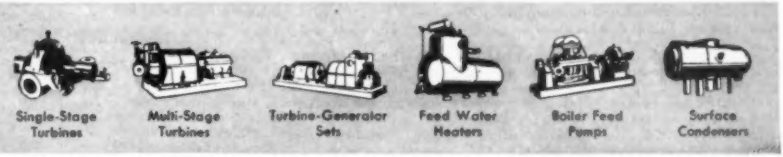
Worthington builds turbine-generator sets in sizes up to 10,000 kw. For detailed proof that *there's more worth in Worthington* . . . call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

WORTHINGTON

STEAM TURBINE GENERATORS

T.T.5

A GREAT TEAM IN STEAM



(Continued from page 118)

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

553—See page 59. 11 Ways to Cut Production Costs: Write for your copy of this free, new booklet which is yours without obligation. You will find handy coupon on page 59. Alemite Div., Stewart-Warner Corp.

554—See page 101. Lubricants: This company offers a wide selection of "Job Proved" petroleum products. The know-how of their engineers and detailed product information are yours for the asking. Sun Oil Company.

555—See page 157. Lubriplate: Write today for authentic information on how these lubricants effect maximum savings even in unusually severe lubrication problems. Fiske Brothers Refining Company, Lubriplate Division.

556—See page 138. Non-Fluid Oil: Send for Bulletin No. 504 and free testing sample of Non-Fluid Oil for positive bearing protection. New York & New Jersey Lubricant Company.

557—See pages 28, 29. Steam Cylinder Oils: No matter what your operating conditions, there is a Sinclair Steam Cylinder Oil made expressly to give the utmost in lubrication satisfaction. For lubrication counsel see your nearest supplier of Sinclair products, or write Sinclair Refining Company.

558—See pages 35, 36. Lubrication Service: Consult your nearest Standard Service-Supply Center for your lubrication needs. Deliveries can be made in a few hours. Also ask about Stanoil for clean, maximum performance in hydraulic units, speed reducers and circulating systems—expert, personal service by Standard Oil lubrication specialist, too. Write for full information. Standard Oil Company (Indiana).

559—See page 113. Lower Lubrication Costs: Refer to coupon on page 113 to request a "Desk-Top Demonstration" of Oil-Mist. This entails no cost or obligation on your part. There is also space to check for additional information about Oil-Mist by mail. Alemite, Division of Stewart-Warner Corp.

MAGNETIC SEPARATORS

560—See page 49. Do You Have a Contamination Or A Separation Problem: Look on page 49 for successful solutions to a variety of contamination and separation problems. Note the coupon at the bottom of this advertisement which offers you free literature. Eriez Manufacturing Company.

MECHANICAL POWER TRANSMISSION

561—See page 39. Multi-V-Drives: Advertisement describes features to look for when buying V-belt drives. Write for Bulletin No. V-1400-B7F for full details on Worthington Multi-V-Drives and QD Sheaves. Send coupon today. Worthington Pump & Machinery Corp.

562—See page 25. Condor Compensated Belt: Longer life and trouble-free service are assured as compensation prevents outer ply ruptures, fastener troubles, and ply separation. Write for Bulletin 6808J, which also explains other features. Raybestos-Manhattan, Inc.

PACKAGED STEAM GENERATORS

563—See page 31. Forced Recirculation Steam Generators: See page 31 for outstanding features of this Clayton self-contained steam plant. Use the coupon to request a desk demonstration of Clayton Forced Recirculation principle and/or catalog. Clayton Mfg. Co.

564—See page 17. Packaged Steam Generators: New, fully illustrated catalog 302 gives complete details for units available in 18 sizes. Write today. Superior Combustion Industries, Inc.

565—See page 152. Packaged Steam Generators: Write for Catalog IP651 for tested data to show how you can reduce your steam costs with a Dutton "Packaged" Steam Generator. Hapman--Dutton Company, Dutton Boiler Division.

566—See page 125. Steam-Pak Generator: Steam-Pak Generators are built in capacities from 15 hp up, for low or high pressure, steam or hot water, for light or heavy oil, combination gas and oil, or straight gas. Write for complete data. York-Shipley, Inc.

PACKINGS & GASKETS

567—See page 51. Navalon Packings: Made of "ramie", these packings give service against fresh or salt water, brine, cold oil, and for use on pumps, elevators, etc. Write for folder PK-32A. Johns-Manville.

568—See page 134. Durametallic Packings: Write for complete information on Durametallic packings for your valve and pump requirements. For perfect low cost sealing. Durametallic Corp.

569—See page 147. Piston Packing: Pumcups cut downtime and material and maintenance costs to minimum, hold volumetric efficiency constant. Write for free Bulletins No. 4401 and 4502. Darling Valve & Mfg. Co.

PIPE AND FITTINGS

570—See page 140. Pipe Fabricating Specialists: Meet your most exacting specification with absolute satisfaction on all pipe fabricating for oil, chemical, concrete, asphalt, and other industrial needs. Albert Pipe Supply Co., Inc.

571—See page 24. Ball-Bearing Swivel Joints: Catalog No. 50 gives full information on more than 500 different types, styles and sizes Chiksan Ball-Bearing Swivel Joints. Write. Chicksan Co.

572—See page 52. Flexible Metal Hose: Troublesome connection problems where there is movement between parts, misalignment, vibration or expansion and contraction are effectively solved with CMH Flexible Metal Hose. Write for literature describing the CMH line today. Chicago Metal Hose Corp.

573—See page 145. Pipe Unions: Bronze-to-bronze joints insure long life and tight joints. Because of precision in manufacture these unions can be disconnected and reinstalled many times. Send for complete information today. Dart Union Company.

574—See page 44. Piping Pointers: Write for your copy of the new 36-page handbook on Piping Pointers. Covers fundamentals of good, sound everyday piping practices. Illustrated for easy understanding. Also available on request is a Piping Pointers 16-mm sound film. Free usage for group training. Write today. Crane Co.

575—See page 121. Drain Pipe: Send coupon on page 121 for Bulletin 703A on Duriron Drain Pipe. High silicon iron pipe, widely used in draining corrosive wastes. Write today. The Duriron Company, Inc.

PUMPS

576—See page 142. New Condensed Pump Catalog: Write for your copy of the condensed Catalog "M". Aurora invites your special pump problems which will be handled efficiently by personnel devoted exclusively to pump design and manufacture. Aurora Pump Company.

577—See page 126. Difficult Pump Problems: Marlow specializes in manufacturing pumps which solves some of industrys' most perplexing pumping problems. Write for complete details. Marlow Pumps.

578—See page 121. Pumps: Send coupon on page 121 for Bulletin P4 on Model 40 Series R Standard Durcopump. Interchangeable for adaptability to all corrosives. Available in all Durco alloys. The Duriron Co., Inc.

579—See page 110. Non-Clogging Centrifugal Pumps: Write for complete information on these Centrifugal Non-Clog pumps used wherever liquids carrying solids and foreign materials must be handled. Consult a Weinman centrifugal specialist. No obligation. The Weinman Pump Mfg. Co.

REFRACTORIES

580—See page 132. Refractories and Insulations: Write for free catalog with complete information on the use of castable, bonding and ramming refractories, and block, blanket, plastic and fill insulations. Refractory and Insulation Corp.

SOOT BLOWERS & TUBE CLEANERS

581—See page 149. Rotojet Tube Cleaners: Rotojet Tube Cleaners, from head to hose, are tailored to meet individual requirements and give you the best combination for a fast, thorough job. Send for new Rotojet Bulletin today. Elliott Company—Roto Division.

582—See page 135. Tube Cleaning and Expanding: Write for sound advice and top service on your tube cleaning and tube expanding problems. Airetool products help you cut down time, give lower maintenance cost, more thorough scale removal. Airetool Mfg. Co.

STEAM SPECIALTIES

583—See page 133. Trap Catalog: Write today for the Strong Trap Catalog 68-J. Includes complete data on the 80 Series Trap available with pressures to 250 lbs. Strong, Carlisle & Hammond Co.

584—See page 160. Steam Traps: Super-Silvertops save you money in two ways—cut down installation costs and keep operating costs low. Write for helpful book, "Solving Steam Trap Problems." The V. D. Anderson Company.

585—See page 142. Automatic Steam and Fluid Control Equipment: Illinois Control Equipment includes combustion control, flow control (electrical or

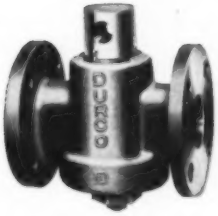
(Continued on page 122)

Corrosives handling equipment by
the best known name in industrial corrosion control

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

Duriron Drain Pipe

High silicon iron pipe, widely used in draining corrosive wastes. Highly resistant to corrosion and abrasion. Installed by usual plumbing methods. Send coupon for Bulletin 703 A.



DURCO Type F Plug Valve

A new valve thoroughly tested in severe chemical service. Operates with no lubrication, no packing, no metal-to-metal contact, no sticking, no fouling and no critical adjustment. Uses Teflon sleeve and DURCO alloys for various corrosive conditions. Bulletin V4/647.

Model 40 Series R Standard DURCOPUMP

An improvement on the popular Series M pump, industry's standard for acid handling. Wet end construction interchangeable for adaptability to all corrosives and is available in all DURCO alloys. Bulletin P 4.

DURCO Exhaust Fans

Highly corrosion resisting, available in Duriron and Durichlor in various drives, sizes and capacities for venting corrosive fumes and vapors. Bulletin M5/1103 contains details.

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, INC.
Box 1019 • Dayton 1, Ohio

THE DURIRON COMPANY, Inc.
Box 1019, Dayton 1, Ohio
Please send literature on
☐ Duriron Drain Pipe ☐ Valves
☐ Exhaust Fans ☐ Durcopumps

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____

readers' guide to advertised products

(Continued from page 120)

pneumatic), zone control, and a complete line of steam heating and power specialties for heating comfort and fuel saving and for industrial process control as well. Write for bulletins. Illinois Engineering Company.

586—See page 68. Impulse Steam Traps: To get equipment hot and into production faster, use Yarway impulse steam traps. Write for your free copy of new 16-page Trap Selector together with full information on how these traps keep equipment continuously at peak operating temperatures. Yarnall-Waring Company.

587—See page 34. Steam Traps: Unique Duo-Step design doubles drainage capacity to give you double value—lets you use smaller, less expensive traps to do larger drainage jobs. Send for information. The Clark Manufacturing Co.

THERMAL INSULATION

588—See page 109. Blanket Insulation: Send for new booklet on B-H Blanket Insulation with interlocking fibers for maximum moisture resistance. Large area flexibility. Baldwin-Hill Co.

TOOLS

589—See page 151. Combination Blower-Suction Cleaner: It's a snap to rid all of your equipment of damaging dirt, dust, and grit with this portable cleaning tool. Write today. Clements Mfg. Co.

590—See page 129. Radial Power Saw: Many machines in one. Every time you change the cutting tool you have another machine. It dadoes, routs, shapes, grinds, tenons, etc. Cutting operation is fast, accurate, safe. Write for catalog. DeWalt, Inc.

TURBINES

591—See page 48. Power Saving Turbines: Eight-page Bulletin S-116 illustrates and describes application, construction, savings effected and advantages of the Terry solid wheel turbine. Write for your copy now. The Terry Steam Turbine Co.

VALVES

592—See page 127. Diaphragm Valves: Newly developed plastic diaphragms now make it possible to handle 66° Be sulphuric acid without leaking, dripping or sticking. An inquiry will bring full details and prices. Available on request. Hills-McCanna Co.

593—See page 131. Rockwell Valves: Feature hydraulic control for shut-off and throttling of air, gases, steam, liquids, semi-solids. Butterfly and slide types—any type manual or automatic control. Write for catalog. W. S. Rockwell Company.

594—See page 54. Check Valves: Chapman Tilting-Disc Check Valves practically eliminate pipe line stresses—head losses are reduced 65% to 80%. Write for bulletin with complete data. The Chapman Valve Mfg. Co.

595—See pages 20,21. Blow-Off Valves: Unit Tandem Blow-Off Valves constructed with special strength and toughness to withstand severest blowdown conditions. Write for Bulletin B-433. Bulletin B-424 describes lower pressure blow-off valves. Yarnall-Waring Company.

596—See page 136. Williams-Hager Check Valves: Available for every service in standard pipe sizes from 1" to 20". Avoid costly water hammer troubles. Write today for Bulletin WH-100. The Williams Gauge Co.

597—See page 143. Micro-Control Valves: Fairbanks 0525 bronze globe valves are a dependable combination of precision working parts and solidly built. Designed for close regulation of flow. 150 lb. steam working pressure. The Fairbanks Company.

598—See page 121. Plug Valve: Send coupon on page 121 for Bulletin V4/647 describing Durco Type F Plug Valve. Operates without lubrication, packing, metal-to-metal contact, sticking, fouling and critical adjustment. Write. The Duriron Company, Inc.

WATER TREATMENT

599—See page 6. Boiler Water Comparators: Low cost, extreme accuracy, simple operation make Taylor Comparators ideal instruments for all plants. Write for 96 page, combination reference book and catalog. W. A. Taylor and Co.

600—See page 47. Cuno Flo-Klean Filter: Makes raw water suitable for many plant services, keeps recirculated water clean, pays for itself in quick time. Write today or send coupon for full information. Cuno Engineering Corp.

601—See page 13. Water Conditioning: Write for sound recommendations of Betz' engineers to help you select the water conditioning service best suited for your plant. W. H. & L. D. Betz.

602—See page 116. Water Softeners: "Double-Check" line of softeners feature newly designed manifold and high-capacity zeolite. The "Double-Check" Method can also be applied to your present softener for dollarsaving advantages and extra capacity. Write for Bulletin 610. Elgin Softener Corp.

603—See page 67. Write for Bulletins: Informative bulletins are available on (1) Dearborn Improved Polyamide Anti-Foams, and (2) Dearborn Industrial Water Treatment and Engineering Service. If you prefer, use the coupon on page 67. Dearborn Chemical Co.

604—See page 64. Water Conditioning: Send your water conditioning problems to Permutit—the only manufacturer of all types of water conditioning equipment and of all types of ion exchangers. The Permutit Company.

605—See page 53. Drew Water Treatment Service: Starts with the conditions that exist in your plant and includes all the corrective and preventive measures required for efficient operation. Consult the Drew Engineer or write for Technical Bulletin on Steam Line Corrosion Control. E. F. Drew & Co., Inc.

606—See page 105. Chlorinators: Reduce down time, cut operating costs, improve heat transfer with the Visible Vacuum Chlorinator for the application of chlorine to cooling water circuits through the W & T De-sliming process. For complete data write today. Wallace & Tiernan Products, Inc.

607—See page 56. Waste Treatment: Infilco can help you with your waste disposal problems with 57 years experience and complete line of equipment for chemical and biological treatment. Consult your nearest Infilco Engineer or write for Bulletin 70-A. Infilco, Inc.

608—See page 19. Waste Treatment System: If you are in need of a waste treatment system, call in GAI consultants specializing in this field. Produces benefits such as recovering raw stock, eliminates stream pollution, and reduces heat losses. A factual treatise offering much useful information is contained in the free booklet "Four Ways To Economize on Industrial Wastes." Write for your copy today. Gilbert Associates, Inc.

609—See page 11. Water Treatment: You get cleaner steam and less blowdown with Nalco Antifoams. Process uses of Nalco Antifoams save time, trouble and money. Write for complete data. National Aluminate Corporation.

610—See page 146. Water Treatment: Hall Plant-Wide Water Service is your assurance that your water problems will be considered both individually and as a whole. Write for new bulletin "Let's Consider Your Whole Water Problem"? Hall Laboratories, Inc.

611—See page 150. Water Treatment: Write for detailed information about solving your water treatment problems. This complete service includes each step from original survey of problem to installation of water purification equipment. General Filter Co.

612—See page 153.. Water Treating Equipment: Get your copy of fact-filled bulletins giving complete data on manual or automatic equipment in all sizes, types and capacities. Hungerford & Terry, Inc.

613—See page 134. Industrial Waste Treatment: Carter's organization offers complete line —of mechanical equipment for industrial waste treatment, water purification and sewage treatment. Consult a Carter engineer today for your industrial waste problem. No obligation. R. B. Carter Sales Inc.

614—See page 27. Water Conditioner: Send coupon on page 27 for Publication 4801 which gives complete information on the Cochrane Hot Process Zeolite Water Conditioner. Gives complete descriptions of apparatus required and its application to many water conditioning problems. Cochrane Corporation.

WELDING & CUTTING EQUIPMENT

615—See page 46. Welding Equipment: Write today for details of new, money-saving oxygen and acetylene supply plan plus complete line of quality welding and cutting apparatus. Linde Air Products Company, Div. of Union Carbide & Carbon Corp.

Dust Control System on Rotary Breaker Screen and sand handling system in a casting plant of one of the nation's largest steel companies.

The large volumes of dust produced in the sand handling operations of this plant are not a problem. As soon as dust is formed, it is removed by the KIRK & BLUM Dust Control System.

One of the many KIRK & BLUM foundry installations, this Dust Control System meets every requirement of the American Foundrymen's Association code; heavy gauge piping has flanged joints and convenient clean-out doors.

Hundreds of plants, large and small, have found it pays in *greater operating efficiency* to have a dust or fume control system designed and installed by experts. For all three—design, fabrication and installation—call on KIRK & BLUM.

If you need a new dust control system . . . or more capacity in an existing one, contact KIRK & BLUM. They'll gladly prove the money-saving efficiency of systems by KIRK & BLUM, specialists in dust and fume control for more than 43 years. For Booklet, write The Kirk & Blum Mfg. Co., 3174 Forrer St., Cincinnati 9, Ohio.

One Undivided Responsibility
DESIGN...FABRICATION...INSTALLATION
For all three—call on K&B

FOR CLEAN AIR... THE INVISIBLE TOOL

KIRK AND BLUM

DUST CONTROL SYSTEMS

NEWS . . . of men and companies

HONORS

American Institute of Electrical Engineers—Donald I. Bohn, chief electrical engineer for the Aluminum Co. of America will receive the Lamme Medal at the annual meeting, June 25.

International Acetylene Assoc.—The 1951 James Turner Morehead Medal has been awarded posthumously to M. Keith Dunham, late president of National Cylinder Gas Co., in recognition of his pioneering leadership in the operating, engineering and economic aspects of the oxy-acetylene industry.

Hercules Powder Co.—Russell H. Dunham, first president and first chairman of the board was honored for his leadership in the creation of the company's research laboratories.

John Wesley Hyatt Award—This honor for distinguished achievement in plastics was given to James Bailey, v-p and director of research of Plax Corp. for work on extrusion of thermoplastics. He received a gold medal and $1000.

SOCIETIES

ASME, Philadelphia Section—G. M. Muschamp, v-p in charge of engineering for Brown Instruments Div., Minneapolis-Honeywell Regulator Co. was elected president, R. W. Worley, United Engineers and Construction, Inc., vice-chairman, J. A. Quaid, Martin Quaid Company, treasurer, and C. C. Franck, Westinghouse Electric Corp., secretary.

Cooling Tower Institute—W. A. Shoudy, consulting engineer of New York City, is made executive manager. He is Fellow and past v-p of ASME.

National Clay Pipe Assoc.—D. M. Strickland, v-p of National Clay Pipe Manufacturers, Inc., was elected president and general manager.

National Constructors Assoc.—Regional chairmen are; J. F. O'Neill, Chemical Construction Co., east coast regional committee; W. S. Scherffius, Koppers Co., engineering and construction div., Great Lakes; L. N. Burke, Lummus Co., gulf coast; J. E. Baugh, Ford, Bacon & Davis Construction Corp., mid-continent; F. R. Stevens, Stone & Webster Engineering Corp., southwest, and J. F. O'Connell, Bechtel Corp., west coast.

Sales Managers' Assoc. of Philadelphia—D. G. Mitchell, president of Sylvania Electric Products Inc. received the 1950 Howard G. Ford Award for his company's achievements in growth of sales during 1950.

Western Society of Engineers—T. G. Robinson has been elected chairman of the gas, fuels, and combustion section. He is president of Meters and Controls, Inc. representatives of The Hays Corp. in Chicago.

NEW REPRESENTATIVES

Fitzgibbons Boiler Co.—Clifford B. Ives & Co. will represent the Plate Products Div. in the Philadelphia area.

General Electric Co.—Machinery and Welder Corp. is distributor for stainless steel arc welding electrodes with stocks in Chicago, Milwaukee, St. Paul, Moline and St. Louis.

Graver Water Conditioning Co.—Flagg, Brackett & Durgin, Inc. is made New England representative. Headquarters are 405 Park Square Bldg., Boston.

Hammond Iron Works—Lacy Mfg. Co. of Los Angeles, and Keyes Tank & Supply Co. of Casper, Wyo. and Provo, Utah are licensed to fabricate and erect all designs of conservation storage tanks by company announcement.

NEW REFRACTORIES INSTITUTE HAS BEEN ORGANIZED

A new trade association known as The Refractories Institute has been formed by the members of the refractories industry. Purpose of the institute is to promote demand for the products of the industry, spur additional research with the objective of still further improving products and processes, and cooperating with government agencies in the interest of the public and the industry.

Approximately forty corporations representing the major portion of the industry have joined the new association. Officers elected are James L. Crawford, of Walsh Refractories Corp., president and W. A. Turner of McLain Fire Brick Co., secretary.

The National Radiator Co.—Heat Transfer Div. announces Jackson Engineering Co., 6144 Ferguson Drive, Los Angeles 22 as its representative in Southern California.

Chas. J. Riley & Sons—Wm. J. O'Brien of O'Brien Steam Specialty Co., Inc., 391 Heffernan Bldg., Syracuse, is eastern representative.

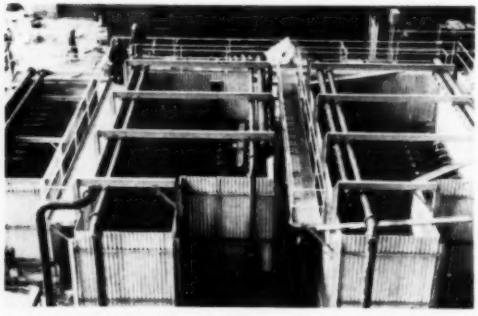
Nordberg Mfg. Co.—E. M. Wakeman & Associates, Lakeland, Florida is industrial distributor for 4FS diesel engines in Florida and the gulf counties of Mobile and Baldwin, Alabama.

SALES OFFICES

American Flexible Coupling Co.—Ehret and Kinsey, Chicago representatives, are now at 141 W. Jackson Blvd.

Bird-Archer Co.—Engineering, sales and service offices have been transferred from 400 Madison Ave., New York to 4337 North American St., Philadelphia, where the company's plant is located. Executive and New York district offices stay in New York.

(Continued on page 126)



Long Island Lighting Co. built a new plant to reform natural gas for a manufactured gas area. Cast iron sections for coolers above were supplied by National Radiator Co.

● A new plant with a capacity of about 35,000,000 cu ft per day was recently built for the Long Island Lighting Co. to convert natural gas to a product approximating the output of the company's water gas plants. The service is for New York areas completely geared to the use of manufactured gas.

The natural gas, recently made available from the Southwest by the Transcontinental Pipeline Co., is reformed by a catalytic cracking process utilizing specially designed furnaces furnished by Surface Combustion Co. The reformed gas is enriched and stored in a new 5,000,000 cu ft holder.

The method of cooling both the compressors and reformed gas is among the outstanding features of the plant. In both instances, it is necessary to employ recirculatory closed water systems because enough ground water is not available for a once-through system and sea water would create a serious corrosion problem.

Jacket water for the compressors and natural gas engines is cooled in the cast iron sections seen in the picture and furnished by National Radiator Co. Salt water is sprayed over the sections, which are designed for a minimum of evaporative cooling to prevent encrustation. Transite walls minimize air flow, also prevent salt water corrosion of surrounding equipment. The system for cooling liquor from the wet-scrubber cooling and cleansing operation is similar.

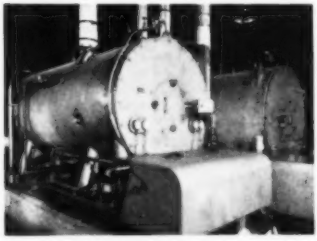
Steam Generators Pay for Selves and Save $10,000 in First Year

Operating Costs Reduced Sixty-Six % With Lower Fuel Cost & Maintenance

Many railroads have effected huge savings by replacing old inefficient boilers with modern packaged automatic steam generators. Mr. O. T. Carroll, Chief Engineer of Peoria & Pekin Union Railway Co., Peoria, Ill., purchased for his company two modern packaged steam generators; a 75 h.p. for stand-by and a 150 h.p. "on-the-line", and reports his savings as follows:

"The operation of the two York-Shipley Steam-Pak Generators installed in our roundhouse to furnish steam for heating the roundhouse and offices is beyond our expectations as to expense and efficiency.

The savings effected in changing from the operation of the old coal-fired boiler will pay for the cost of installation and the first year's operation."

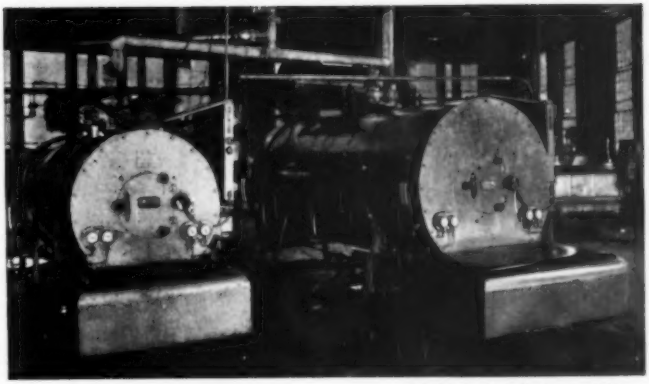


The total investment for these two new generators, fired with low cost Bunker C heavy fuel oil, was approximately $35,000. Cost of fuel and maintenance annually was reduced to approximately $8,000.00—a 66% reduction, based on the average operating cost of the old plant of $53,000.00 per year.

Maintenance cost old boiler	$53,000.
Cost of new equipment	35,000.
Operating cost new equipment	8,000.
Total cost first year	$43,000.
First year's savings	$10,000.
Estimated 2nd year savings	$45,000.

These modern Steam-Pak Generators, manufactured by York-Shipley, Inc., York, Pa., are showing similar savings in hundreds of installations all over the country.

(Advertisement)



Multiple installation at Monon Railroad, Indianapolis, saves $1,000.00 per month in fuel and labor.

STEAM-PAK GENERATOR

YORK POWER

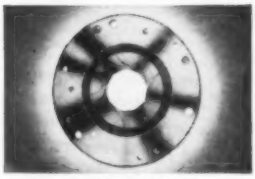
A PRODUCT OF YORK-SHIPLEY

SAVE MONEY

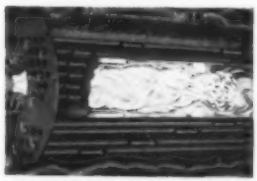
They're Built For Maximum Efficiencies In Operation . . .

- Engineering design recognized by top engineers and architects.
- Satisfactory operation in thousands of buildings all over the country.
- Tremendous savings proven by hundreds of case histories.
- Distributors chosen for their engineering ability, trained to provide the best engineering "know-how."

These are four basic reasons why Steam-Pak should be No. 1 on your list of steam generators.
See your nearest York-Power Distributor or write York-Shipley for complete details.



IRIS SHUTTER
Patent protected feature provides precision control of burner air, accurately synchronizing air-oil adjustment.



NEW FIRE CONTROL
Swirling flame action speeds gas flow, increasing heat absorption and combustion efficiencies.

Steam-Pak Generators — from 15 h.p. up, for low or high pressure steam or hot water, for light or heavy oil, combination gas and oil or straight gas.

YORK SHIPLEY

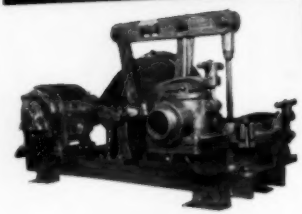
616 JESSOP PLACE · YORK, PENNSYLVANIA · PHONE 7861

Industrial Division

In plant after plant it's

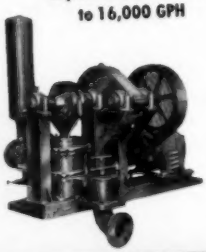
MARLOW PUMPS PREFERRED

for handling difficult industrial wastes



There are more Marlow sludge pumps and more Marlow diaphragm pumps in service handling waste materials than all other makes combined.

Capacities from 1,000 to 16,000 GPH



Marlow Pumps also makes the world's most complete line of self-priming centrifugal pumps, and has the largest pump distribution and service organization . . . your assurance of complete pump satisfaction.

For details see your Marlow distributor or write the factory

MARLOW PUMPS

515 GREENWOOD AVENUE

RIDGEWOOD, NEW JERSEY

Leading manufacturer of Self-Priming Centrifugal and Sludge Pumps

SALES OFFICES

(Continued from page 124)

Fairbanks, Morse & Co.—A new sales and service office is located at 3000 West 117th St., Cleveland.

Raytheon Mfg. Co.—The New York and International Sales Offices are transferred to 19 Rector Street, New York 6.

United States Rubber Co.—New branch office and warehouse is open at 900 So. Jefferson Davis Parkway, New Orleans to serve Louisiana and parts of Alabama, Florida and Mississippi.

EXPANSIONS

Aluminum Co. of America—New aluminum smelting plant, for 170,000,000 lb of aluminum annually, will be built at Wenatchee, Wash.

Barksdale Valves—Recently moved to their own plant at 1566 East Slauson Avenue, Los Angeles. L. S. Barksdale, president, will now devote full time to the company.

Borg-Warner Corp.—Ingersoll Products Div. has announced plans for 30,000 sq ft of new construction for manufacture of steel cartridge cases.

General Electric Co.—A major addition to the Schenectady turbine plant will add more than 80,000 sq ft.

General Motors Corp.—Fabricast Div. will erect a plant for manufacture of aluminum castings at Jones Mills, Ark., with 100,000 sq ft of floor space.

B. F. Goodrich Co.—Construction on added facilities for the Research Center is started at Brecksville, O.

Goodyear Tire & Rubber Co.—The company will begin rehabilitation of and later operate the unit of Indiana Arsenal located at Charlestown, Ind. Initial output of explosive charges is expected to employ 3,500 persons.

International Harvester Co.—Construction of a building for a service parts depot and a general sales district office and warehouse in Denver has been announced by the Industrial Power Div. It will cost approximately $1,500,000.

Laclede-Christy Co.—Plant and physical assets of Paterson Fire Brick Co. at Clearfield, Pa., were purchased. Additional facilities will be added immediately for refractories.

Link-Belt Co.—Construction of an engineering and manufacturing plant for production of elevating, conveying and processing machinery is started on a 43-acre site at Colmar, Pa. It will have about 300,000 sq ft of floor space.

Minnesota Mining & Mfg. Co.—Details of a $6,500,000 program were announced for expanding facilities at Atlanta; Bristol, Pa.; Buffalo; Cleveland; Lemont, Ill.; Wayne, Mich.; Boston; and Hastings, Hutchinson and St. Paul, Minn.

Monsanto Chemical Co.—Substantial expansion of research facilities at Nitro, West Va., will be provided by an air-conditioned, two-story, brick and steel structure.

%Proportioneers, Inc.%—Synchro-Master Co. was acquired and will operate as the Synchro-Master Div., with sales and production in Providence, Rhode Island.

Turner Construction Co.—United Aircraft Corp. will finance privately a $20,000,000 expansion of two east Hartford divisions. The new plants are being designed by Albert Kahn Associated Architects and Engineers.

Westinghouse Electric Corp.—Formation of a new Air-Arm Div. and plans for a new plant for aerial warfare equipment were announced. On 75 acres on a corner of the Baltimore Friendship Airport, the new 400,000 sq ft plant, with offices and an engineering laboratory, will employ 2,500 to 3,000 by the end of 1952.

Plans for an electronic tube manufacturing plant on a 70-acre site in Bath, N. Y., for approximately 2000 employes, were announced.

APPOINTMENTS

Allis-Chalmers Mfg. Co.—C. W. Bloedorn was named southeast regional representative for the steam turbine dept. with headquarters in Atlanta.

Aetna Ball and Roller Bearing Co.—J. J. Rozner is elected v-p in charge of operations.

American Wheelabrator & Equipment Corp.—S. F. Krzeszewski was elected v-p.

Ampco Metal, Inc.—L. C. Begg is appointed district manager of the newly established Buffalo sales div.

E. A. Livingstone L. E. Sawyer

The Babcock & Wilcox Co.—Luke E. Sawyer, formerly executive v-p was elected president; Alfred Iddles, formerly president was made chairman of the board. Isaac Harter, formerly chairman was named a consultant and E. A. Livingstone, v-p of sales, was given broader responsibilities.

Borg-Warner Corp.—G. E. Campbell was made works manager and D. A. Sutherland, industrial sales manager for Pesco Products Div.

Byron Jackson Co.—T. R. Colville will manage all advertising and sales promotional activities.

Bulldog Electric Products Co.—At the new branch factory in Urbana, O., opened for manufacture of duct plugs, officers are: W. R. Turner, president; J. H. Fribley, v-p; K. K. Kahler, secretary; and J. R. Hornung, treasurer.

Catalytic Combustion Corp.—R. J. Ruff has been elected president. He is co-inventor of the Suter-Ruff process for fume elimination.

Chain Belt Co.—L. B. McKnight is made executive v-p. He is current president of National Association of Conveyor Equipment Manufacturers.

Combustion Control Corp.—L. D. Sibley was appointed v-p of sales.

The Binks Manufacturing Co.—Karl W. Osterstrom has been appointed manager for material handling pumps div. in charge of sales, engineering and development.

J. J. Tipton K. W. Osterstrom

Hays Corp.—J. J. Tipton is made chief project engineer. J. R. Heming becomes project engineer in charge of combustion control.

Dearborn Chemical Co.—H. A. Kreith was made purchasing agent. He formerly was a sales representative for McKesson & Robbins, Inc.

DeLaval Steam Turbine Co.—T. A. Nilsen is made district manager of a new Texas district office in the Esperson Building, Houston.

DeWalt, Inc.—Ernest Lux will supervise sales in western Pennsylvania and in West Virginia except Martinsburg. James Carpenter is now district sales manager in Maine, N. H., Ver., Mass., and R. I.

Esterline-Angus Co., Inc.—R. F. Lamb has been appointed sales and service engineer in western New York succeeding Dean Thomas, deceased.

Foster Wheeler Corp.—G. D. Dodd, assistant to president, will assume charge of manufacturing at the Carteret, N. J. and Dansville, N. Y. plants, succeeding William Lonsdale, retired.

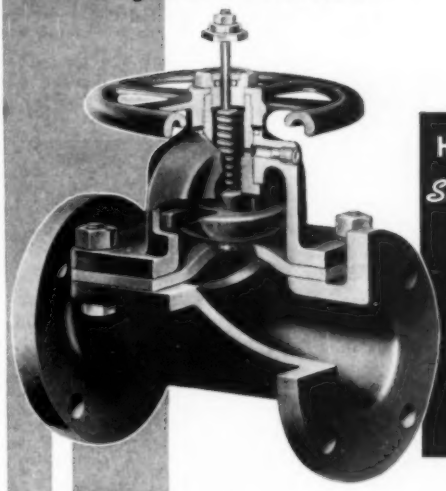
General Ceramics & Steatite Corp.—F. F. Sylvester has been appointed to the staff.

General Controls Co.—R. L. Day is factory sales engineer with headquarters at the Glendale plant.

General Electric Co.—S. V. Travis has been appointed ass't general sales manager of the Large Apparatus Div. He is succeeded as manager of sales for the Large Motor and Generator Div. by L. J. Matthes. L. B. Gezon and O. A. Huntsman have been appointed sales manager and ass't sales manager of the metal-clad and switchboard section of the Switchgear Div.

R. E. Whitmyer was made comptroller of the Air Conditioning Dept. with headquarters at Bloomfield. C. B. See-

Here is the valve that revolutionized flow control of Sulphuric Acid . . .



HILLS-McCANNA *Saunders Patent* DIAPHRAGM VALVE *with* L-1 PLASTIC DIAPHRAGM

Sulphuric acid up to 66° Bé can now be valved without leakage, dripping or sticking . . . with Hills-McCanna Diaphragm Valves equipped with the new L-1 plastic diaphragms. This new development combines the tried and proved Saunders Patent pinch clamp principle with a diaphragm of a special type of plastic that is particularly resistant to concentrated sulphuric acid.

Hills-McCanna Diaphragm Valves with L-1 diaphragms are suitable for temperatures up to 125° F. and pressures up to 100 psi. Sizes from ½" thru 4" are available, handwheel operated, quick opening (lever operated) and sliding stem models. Choice of nearly 50 body materials or linings including cast iron, cast steel, Durimet or glass lined.

Literature is available describing Hills-McCanna Valves with data on their use for acid and other services. Write for your copy outlining the nature of your application. HILLS-McCANNA COMPANY, 2355 W. Nelson St., Chicago 18, Ill.

The valve illustrated in cut-a-way above is the Hills-McCanna Model 6600 semi-sealed bonnet acid valve with L-1 plastic diaphragm and tell-tale travel stop indicator. Valves of this type can be furnished where particularly rigid safety precautions must be taken.

HILLS-McCANNA CO.

saunders patent

diaphragm valves

Also manufacturers of— Proportioning Pumps

Force-Feed Lubricators • Magnesium Alloy Castings

APPOINTMENTS
(Continued from page 127)

lig, ass't manager of Fitchburg (Mass.) turbine sales division; G. E. Walter, ass't. division engineer of the Specialty Transformer Engineering Div. at Fort Wayne; C. E. Moeller, assistant to manager of engineering of the Fractional Horsepower Motor Div.

B. F. Goodrich Chemical Co.—W. S. Richardson, president, has been elected a v-p of The B. F. Goodrich Co.

Great Lakes Carbon Corp.—H. E. Lewis has the new position of general sales manager of industrial sales dep't., Perlite Div.

Hitchcock & Estabrook, Inc.—Marc V. Sullivan, with 20 years experience, is added to the staff.

Insul-Mastic Corp. of America—C. E. Hall was made controller.

Key Company—L. W. Matthey was elected ass't general manager and F. B. Riggan, v-p in charge of research and development.

Laclede-Christy Co.—D. M. Watkins, formerly president and treasurer, was elected chairman and president.

Link-Belt Co.—R. W. Rausch is consulting engineer and J. J. Richard, chief engineer. R. W. Suman is chief engineer of the Philadelphia plant.

Lone Star Steel Co.—New board-of-directors members are J. T. Crim of Kilgore, C. P. McGaha of Wichita Falls, and Robert Foree and Frank Ryburn, Jr., both of Dallas.

Masonite Corp.—E. R. Graebner is made industrial sales manager to succeed R. T. Miller, who resigned to join Barclay Mfg., Inc.

Monsanto Chemical Co.—Dr. C. A. Thomas, leading atomic scientist, was elected president.

Nooter Corp.—Robert J. Ryan was made president succeeding the late Elmer J. Nooter.

J. M. Monroe **W. C. Young**

Nordberg Mfg. Co.—W. C. Young was transferred to the company's Washington, D. C., office. J. M. Monroe replaces him in the Milwaukee office. These appointments were announced by the heavy machinery div.

Owens-Corning Fiberglas Corp.—E. W. Pat Smith was elected v-p in charge of merchandizing and advertising.

Rockwell Mfg. Co.—R. J. Brown is appointed advertising and sales promotion manager of Delta Power Tool Div. Previously, he was with Crane Packing Co.

United States Steel Corp.—J. F. Scott was made tubular products division manager of general sales.

Union Carbide and Carbon Corp.—Fred H. Haggerson, president, has also been elected chairman of the board of directors. M. G. Dial was elected executive v-p and Dr. G. O. Curme, v-p in charge of research.

Worthington Pump & Machinery Corp.—A. F. Reinking, formerly ass't sales manager, has been named manager of the Steam Turbine Sales Div. His headquarters will be at the Wellsville plant. He joined the company in 1936.

A. F. Reinking

Westinghouse Electric Corp.—E. W. Ritter, manager of the new Electronic

(Continued on page 130)

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

IDENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

GENERAL — REG. U.S. PAT. OFF.

ANTHRACITE
Hazle Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*

Capable engineering personnel and the experience gained through long and varied marketing activity assure proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company

123 SOUTH BROAD STREET PHILADELPHIA 9, PA.

CABLE ADDRESS, GENCO

Branches:

BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

How many ways can a versatile DE WALT save money and speed up production in your plant?

PLANT MAINTENANCE
PATTERN SHOPS
CRATING AND BOXING
METAL CUTTING
OUTSIDE CONSTRUCTION

Today—with a national emergency at hand—all industrial plants are seeking ways to keep production in high gear, and cut costs.

DeWalt is the ideal, all-purpose machine you need to achieve these ends.

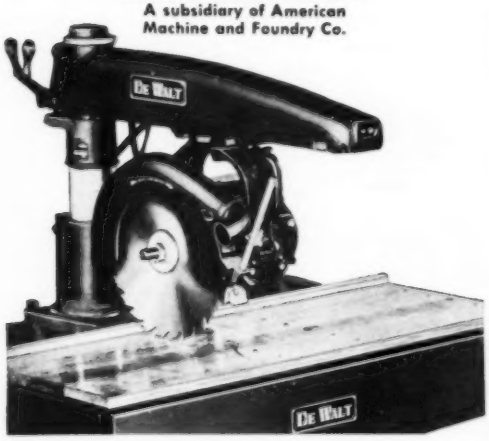
Thousands of industrial plants are now using this versatile machine for maintenance work—for crating and boxing—for car blocking and bracing—for pattern shops—for outside construction work—for light metal cutting.

DeWalt is many machines in *one!* Every time you change the cutting tool you have another machine! It dadoes, routs, shapes, grinds, tenons, etc. Every cutting operation is fast, accurate, safe.

DeWalt takes little floor space—streamlines all your cutting operations.

Investigate DeWalt! It has always been *first* in the radial power saw field—first in mechanical features, first in performance! Write for catalog. DeWalt, Inc., Dept. IP-6, Fountain Ave., Lancaster, Pa.

DE WALT INC.
A subsidiary of American Machine and Foundry Co.



Here's How to

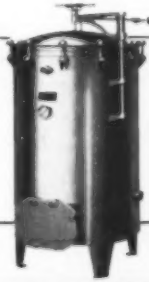
✓ MINIMIZE DISPOSAL PROBLEMS
✓ SAVE SOLUBLE, CUTTING and HYDRAULIC OILS — INDUSTRIAL WATER

FLOTATION UNITS WITH CAPACITIES FROM 20 TO 1000 GPM

HOFFMAN
Filtration Equipment

The Hoffman Flotation Unit (above) continually clarifies soluble oil and water coolants by aerating waste solids into a froth which is skimmed off for automatic removal in near-dry condition. Conserves water . . . aids in reduction of rancidity and bacteria . . . increases machine tool productivity. Write for technical bulletin A-690.

PRESSURE and CARTRIDGE FILTERS in a Wide Range of Sizes. Write for Bulletins and for *FREE ENGINEERING SURVEY.*



FILTRATION DIVISION
U.S. HOFFMAN MACHINERY CORPORATION
219 LAMSON STREET, SYRACUSE 6, N. Y.
CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO. LTD. NEWMARKET ONT.

APPOINTMENTS

(Continued from page 128)

Tube Div. is named a v-p, and E. V. Huggins is made executive v-p of Westinghouse Electric International Co.

H. L. Niederauer is made manager of advertising and sales promotion for the Lamp Div.

J. E. McDonald was made ass't manager, air handling engineering, of the Sturtevant Div.

T. R. Lawson was made ass't sales manager of industrial products with headquarters in East Pittsburgh.

L. J. Wing Mfg. Co.—Frank Story was appointed advertising and sales promotion manager.

York Corp.—W. R. Eby is named manager of the Pacific district. He succeeds R. F. Lauer, recently made v-p of engineering and research. T. A. Marshall is made industrial sales manager for the Pacific district.

OBITUARIES

Combustion Engineering-Superheater, Inc.—Ward S. Patterson, executive assistant to the v-p in charge of engineering, died May 21. He was a member of Tau Beta Pi and was active in the ASME.

James M. Kenny, contract engineer, died May 12.

Conveyor Equipment Manufacturers Assoc.—Dean P. Reed, president, Kanawha Mfg. Co. died April 20. He was active in the formation of the Conveyor Association, and in the affairs of the coal preparation group.

Ekco Products Co.—C. C. MacBurney, the company's first salesman, died recently.

Esterline-Angus Co., Inc.—Dean Thomas, sales engineer, died recently.

Nooter Corp.—Elmer J. Nooter, president, died April 14. Though only 42, he had devoted 25 yr to the industry.

MEETINGS and EXHIBITIONS

Highlights of coming meetings that will aid executives and engineers in planning itineraries. For additional information, please write sponsors of meetings

JUNE

National Congress of Applied Mechanics, the first, will be held June 11-16 at Illinois Institute of Technology under sponsorship of the U. S. National Committee on Theoretical and Applied Mechanics, a joint committee of ASME, AICE, SESA, ASCE, IAS, AMS and APS. Several government organizations and midwestern universities are cooperating. Write to Illinois Institute of Technology for details.

American Society of Mechanical Engineers semi-annual meeting will be held at the Hotel Royal York, Toronto, Can., June 11—15. The meeting will include many technical sessions and plant trips and is one of the major administrative events of the society.

Heat Transfer and Fluid Mechanics Institute holds the fourth annual meeting at Stanford University, Stanford, Calif., June 20—22.

American Institute of Electrical Engineers annual and summer general meeting will be held at the Hotel Royal York, Toronto, Can., June 25—29. In addition to technical sessions, inspection trips and the report on election of officers is included. Write to H. H. Henline, AIEE, 33 West 39th St., New York for details.

International Commission on Illumination will hold an annual session June 25 to July 4, 1951 in Stockholm, Sweden. New offices of the I.C.I. have been opened at 570 Lexington Ave., New York, N. Y., under direction of Secretary General R. J. Whitney.

Oil and Gas Power Div. of ASME—Twenty-third annual conference and exhibit will be held in the Baker Hotel, Dallas, June 25 to 29. Besides technical sessions, program includes inspection trips to the two largest internal combustion engine installations. ASME, 29 W. 39th St., New York, N. Y.

AUGUST

American Institute of Electrical Engineers pacific general meeting will be held at Multnomah Hotel, Portland, Oreg., Aug 20—23. Technical sessions and inspection trips, including the Bonneville Dam Power House, are scheduled. Write to H. H. Henline, AIEE, 33 West 39th St., New York, for information.

SEPTEMBER

National Instrument Conference and Exhibit will be held in the Sam Houston Coliseum in Houston, Texas, September 10-14. Write the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa., for information.

American Society of Mechanical Engineers holds its fall meeting at Hotel Radisson, Minneapolis, Sept. 25—28.

REVIEWS of RECENT BOOKS . . .

Recent books, published for men responsible for The Engineered Plant Services, are reviewed here. Write to the publisher for those in which you are interested

Construction

"Materials of Construction," by John H. Bateman, professor of civil engineering, Louisiana State University. Published by the Pitman Publishing Corp., 2 West 45th St., New York 19, N. Y. 568 pages, illustrated. Price $6.50.

This book was developed as a text to introduce the student engineer to a background knowledge of the raw materials, production and properties of the principal materials of construction. However, the practicing engineer may also find the book a helpful text for general information on common materials of construction.

The book covers mineral aggregates, cementing materials, concrete, structural clay, building stone, lumber and timber, the manufacture and properties of various kinds of iron, steel and alloy metals, and a final section on structural aluminum and magnesium.

Circuit Breakers and Relays

"Power System Stability", Vol. II, by Edward W. Kimbark, Professor of Electrical Engineering at Northwestern University Technological Institute. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Illustrated, 288 pages. $8.00.

"Power Circuit Breakers and Protective Relays" is the subtitle and subject of the second volume of the proposed three-volume work. Construction, operation and auxiliary devices of power breakers are described along with the arc extinction characteristics and transient line conditions encountered. Circuits, construction, operation and theory of the various types of pilot relays is given comprehensive coverage which includes material on rapid reclosure of circuit breakers and performance of protective relays during power swings and out-of-step conditions.

Material on these subjects is a vital part of the work because the most important means of improving transient stability are: (1) faster clearing of faults by means of faster breakers and relays and (2) rapid reclosure of breakers. Publication of this material in a separate volume, however, is intended to make it more useful to those who are primarily interested in power system protection rather than stability in its entirety.

Circuit Analysis

"Circuit Analysis of A-C Power Systems", Vol. II, by Edith Clarke, Professor of Electrical Engineering at the Uniersity of Texas. Published by

John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Illustrated, 396 pages. $8.50.

Intended as a textbook as well as a reference book for power system engineers, methods of procedure in determining performance of a-c power systems under both normal and abnormal operating conditions are presented. Special attention is also given to the development of equivalent circuits for use in the component networks.

As in the first volume, circuits are analyzed by means of components, and the basic equations derived in the earlier work are tabulated for ready reference. Insulated cables, various types of transformers, synchronous machines and induction motors are among the subjects discussed in detail. Overhead transmission lines, treated in Vol I, are not included. Among the characteristics included are skin effect, effects of open conductors in three phase circuits and impedances seen from relays during power swings.

1951 Guide

"ASH&VE Guide," published by the American Society of Heating & Ventilating Engineers, 51 Madison Avenue, New York 10, New York. Illustrated with photographs, charts and drawings. Contains 1476 pages. Price $7.50.

New, enlarged and improved edition is now available and contains the latest and most up-to-date information on heating and air-conditioning developments in the industry. New material includes: design of panel heating systems, large size (24x32 in.) ASH&VE psychrometric chart printed in two colors, solar heat gain and cooling load capacity requirement determination, and latest ASA symbols for use on drawings of heating, ventilation and air-conditioning systems.

This handbook is divided into seven sections that will aid the engineer and consultant to solve problems of design, selection and erection. The tables and other scientific data have been brought up to date and carefully checked by the Guide committee.

Fuels and Combustion

"Fuels and Combustion Handbook," by Allen J. Johnson and George H. Auth. Published by McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 18, New York. Contains 916 pages, illustrations, tables, charts and other helpful data. Price $12.50.

Here is a practical handbook that contains factual data on the properties, characteristics and application of all solid, liquid and gaseous fuels. Basic types of combustion of these fuels is given along with operation and use of the proper combustion equipment.

Treated also are such factors as the determination of heat balances, smoke prevention, draft requirements, selection and purchase of fuels, fuel handling and storage and the transfer and generation of heat.

Advance developments in synthetic fuels, the heat pump, gas turbines, spreader stokers, combustion, furnace and equipment design and packaged boilers are completely covered. Technicians, engineers and operating personnel will find this book a valuable source of information and data, and an indispensable reference in the treatment of fuel and combustion problems.

Easy Positive Flow Control and Quick Shut-Off

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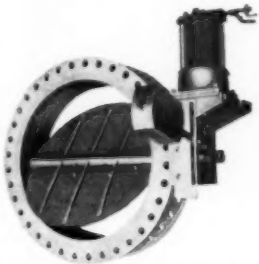

Large butterfly valve with air or hydraulic cylinder.

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Threaded butterfly valve, 1" to 4" sizes, manual or automatic control.

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Full unrestricted flow of water, slurries, semi-solids, air or gas, and quick, positive, accurate regulation and shut-off. Built of any metal or rubber-lined. Pipe sizes 1" to 72". Pressure standard to 50 p.s.i. and special for higher pressures. Made for any temperature from sub zero to as high as 1800° F.

Control — Manual: lever, hand wheel, chain wheel, chain lever, etc. Automatic: electric motor, air diaphragm, air or hydraulic cylinder, solenoid, float, or other types, with positioners and special remote control mechanisms, if desired.

Wafer Butterfly Valves — rugged, lightweight, require only 1 set of bolts; sizes 4" to 72"; any type of control.

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Standard—Made in threaded or flanged 1" to 20" sizes, with pull handle, lever or wheel control. Built of any required metal.

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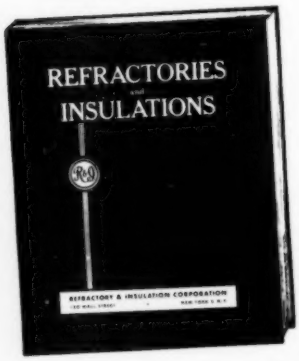

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NEW EQUIPMENT AND DEVELOPMENTS

(Continued from page 24)

capping is snapped into place and the receptacle wired. While the fitting is furnished with a duplex receptacle, it will accommodate all standard devices. Positive grounding is assured due to the manner in which the bottom of the fitting grips the base of the continuous raceway which runs through the fitting.

28—MOTOR TIMER HAS WIDE RANGE

General Control Co. has designed a synchronous-motor timer for accurate control of a wide variety of timed operations. This timer can be used for all time periods between ½ sec and 24 hr. It actuates five s.p.d.t. load contacts independent of the

timer-control circuits. There are two separate solenoids—one operates the clutch and timing mechanism, the other actuates the load contacts. It automatically resets for each new cycle. The device is mounted in a cast frame with an "O" ring-drive assembly that eliminates gears. The pre-set interval and the elapsed time are both clearly visible on the 3-3/8 in. dial. Available for either 115 or 230-v a-c. Outside dimensions are 4½ in. wide, 4-1/8 in. deep and 7⅛ in. high.

29—BANTAM COLLECTOR HAS 437 CFM CAPACITY

A dust collector, the smallest in the line of out-of-doors exhaust type units announced by Aget-Detroit Co., is especially intended for use where remotely located dust sources have toxic fumes, vapors or obnoxious odors. The unit is entirely self-contained, has a capacity of 437 cfm and is powered by a 1/3 hp 3600 rpm continuous duty motor direct driving a self-cleaning paddle-wheel type fan. Dust laden air, carrying shavings, chips, dust, dirt, along with obnoxious odors and toxic fumes, is sent into a cyclone separator. All the material is removed from the air stream except the toxic odors, fumes and the extremely fine dusts, which are exhausted through the outlet at the top of the cyclone. Ordinary sheet metal pipe may be used to complete that part of the installation. Operation is for 110-v, single phase, 60 cycle power, but 220 or 440-v, three phase, 60 cycle a-c power units are also available.

30—SERVICE TAP HAS BEEN ADDED

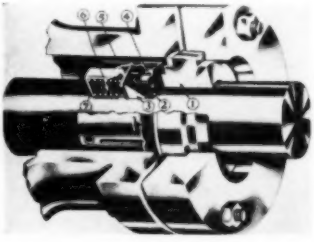
O. Z. Electrical Mfg. Co. has added a service tap to its line of electrical connectors. This tap is cast of high strength copper alloy for heavy-duty service connections for both inside and outside use. Casting is designed to swivel and permits easy insertion of conductors. The construction is such that it keeps tap assembled when clamp is open. Serrations on both body and cap prevent

cables from working loose after tap is installed. Conductors are forced into high pressure contact by means of two standard hex head cap screws. Spacer is available if desired for separating individual conductors. Available in sizes from No. 2 to 1000 mcm (Main) and No. 10 to 1000 mcm (Tap).

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

31—PACKING SEAL MADE OF TEFLON

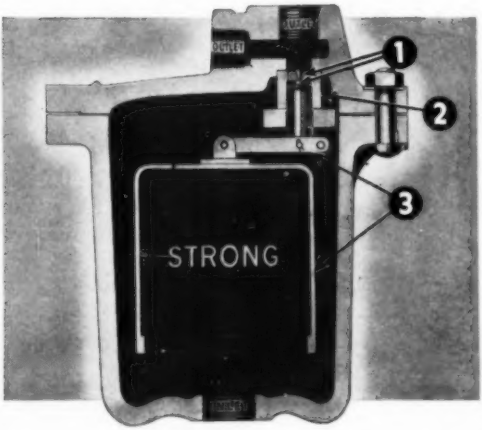
The Crane Packing Co. has just announced an improved mechanical seal that performs effectively under severe tempera-



ture and corrosive conditions. This seal incorporates a flexible ring molded from Teflon, which enables it to combine the chemically-inert properties with the flexibility and positive sealing components essential to effective mechanical sealing. It has high heat resistance, extremely low

(Continued on page 134)

3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
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STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 68-J describes inverted, open bucket and other types of STRONG traps. Write today. Send for Catalog 68-J today! *Trade Mark Reg. U. S. Pat. Off.

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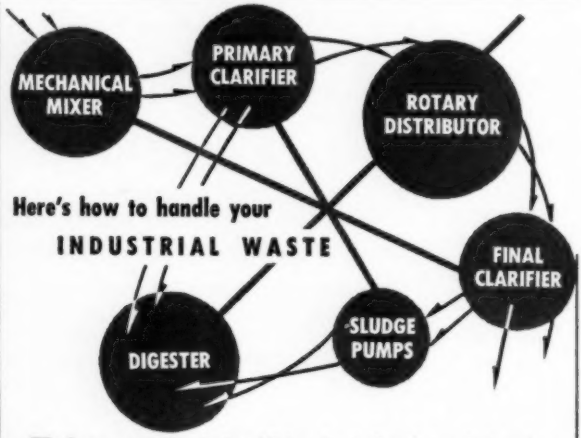

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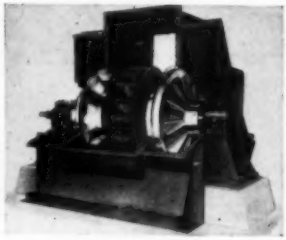
SELF PRIMING CENTRIFUGAL PUMPS ● PLUNGER PRESSURE PUMPS

(Continued from page 132)

friction and chemical inertness. Operates with consistent efficiency on varied corrosive services never previously handled by conventional, flexible-type mechanical seals. Can be employed at temperatures up to 500 F. Designed for service on various rotating shaft applications, such as centrifugal pumps, turbines, positive displacement pumps and agitators.

32—CONTROL VARIES FAN OUTPUT

Control of fan output from 15 to 100 per cent of full load is provided by a new type of vane control available from the Westinghouse Electric Corp. Designed for use with fans for mechanical draft, industrial applications and ventilating service. No change in speed of either fan or motor is necessary



because vane control changes spin of entering air to modify fan pressure. This provides instant response and permits use of efficient constant-speed squirrel-cage motors. Heavy steel vanes are welded to tubes that pivot about steel rods. These rods are supporting members for the cast-iron center. The outer supporting member is a rolled-steel inlet flare stiffened to provide rigidity in all directions.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

33—RUBBER SEALS FOR SEVERE TEMPERATURES

"O"-rings and other precision molded seals may now be obtained in a newly developed extreme temperature range synthetic rubber compound by The Parker Appliance Co. Resistant to non-fuel petroleum products such as lubricating oils and hydraulic fluids, this compound functions effectively in sealing performance anywhere in the temperature range of from —85 to +275F. The compound is also especially satisfactory for service with ozone, having an ozone resistance of 0.003 per cent for six hours. Other physical characteristics are: tensile strength 2000 psi, elongation 300 per cent, Shore A hardness 60+5 and permanent set 3 per cent.

34—INDICATOR HOLDER HAS MAGNETIC BASE

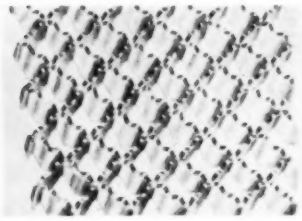
A versatile tool is announced by Enco Mfg. Co. that attaches with a 100 lb pull to flat or curved surfaces for holding securely all dial indicators precisionally in place. The unit has a fingertip release for removal

or positioning the holder without jarring the indicator being held. The set includes accessories for accommodating all stem type, hole type and lug back indicators. It consists of: a magnetic base holder constructed of non-breakable molded plastic, 1¼ in. wide, 4 in. long and 1⅝ in. high. Parallel steel ribs 2-1/4 x ¼ x ¼ in. provide the mag-

netic contact surface on the bottom of the unit. Magnet release, helical design, which operates by a fingertip lever conveniently accessible is located on the bottom. At the top end of the unit is a post 4 in. in length with ball stem, socket and lock nut construction.

35—FLOOR GRATING PROVIDES TRACTION

Grating, of unusual traction, manufactured by Bustin Iron Works, Inc., will prove a superior non-slip quality in all industrial uses where excessive oil, grease, water and icy conditions make walking and working



hazardous, and where drainage and sanitation are desirable factors. Especially adaptable for platforms, stair treads, ramps, catwalks, running boards, skidmats, steps for trucks, trailers, submarine decks, ladder rungs, ships, railroad industry, machine treadles and engine rooms.

36—DUST ANALYZER DETERMINES SOURCE

An instrument for use in analyzing air-pollution problems in highly industrialized areas has been developed by Battelle Institute. Direction from which dust comes now can be determined, and it will be ideal in industries and municipalities to locate sources of air-pollution nuisance. This instrument will provide an index of the general location of plants that may be responsible for heavy dirt fall. It will evaluate the amount of dirt blown from surrounding areas as well as the amount originating from a specific location.

The dirt-fall collector, which will be made commercially available by Eberbach &

to recondition tubes
use AIRETOOL tube
cleaners and expanders

Airetool boiler tube cleaners safely and swiftly remove power wasting scale from both straight and curved boiler tubes. The Airetool cleaner illustrated is designed for straight or curved tubes. The forwardly swing arm head is most effective in cleaning boiler tubes of short radii.

This type of boiler tube expander has great expanding force which insures tight tubes. It is furnished with header, drum and short series mandrels. It is just one of many AIRETOOL expanders available for perfect tube rolling.

For full details on the RIGHT tube cleaning, expanding and maintenance equipment for your boiler tubes, write, wire or phone THE AIRETOOL MFG. CO., 318 S. Center St., Springfield, Ohio.

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of noble metal thermocouple cost

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ENGELHARD RECLAIMING PROCESS

ON ONE 30" long platinum thermocouple, the Engelhard Reclaiming Process saved 53% as compared to the cost of a new unit. On another, the saving was 74%. These are typical examples of how Engelhard Reclaiming — including application of scrap value of old noble metal thermoelements against cost —can stretch your equipment dollar. What's more, Engelhard restores old thermoelements to like-new condition . . . in just 48 hours, if necessary.

ENGELHARD also manufactures a line of wide-range thermocouples and accessories to meet your specific conditions of atmosphere and temperature. For complete information on either Repairs and Reclaiming or New Couples, fill out coupon below and mail today.

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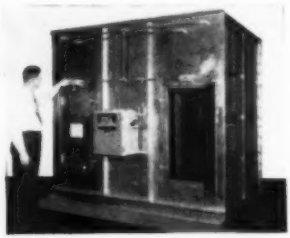
Son Co. is designed to collect heavy dirt from any direction the wind is blowing. For a reliable indication of the source of heavy contamination the instrument must be exposed for a 30-day collection period over many months in a carefully chosen location representative of a given area. The amount of collected material must be correlated with data obtained from the Weather Bureau. A so-called "wind-rose pattern" shows the number of hours the wind has blown from the eight points of the compass. Knowing this, it is then possible to determine the relative amount of dirt that has fallen per hour into the instrument from the various directions. For a complete dirt-fall collection program, several directional dirt-fall collectors are required. Simultaneously, fine particles, gas and odor concentrations in the air, along with weather conditions, may be analyzed using other appropriate instruments and equipment.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

37—ELECTRONIC AIR CLEANER COMES ENCASED

An encased Precipitron electronic air cleaner is available from Westinghouse Electric Corp. in air cleaning capacities ranging from 8330 cfm at 90 per cent efficiency to 44,000 cfm at 85 per cent efficiency. Efficiencies are measured by U. S. Bureau of Standards Blackness Test Method. A 90 per cent efficiency results when the air velocity is 333 fpm. When the velocity

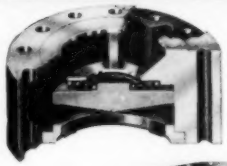


is increased to 400 fpm (up 20 per cent) the efficiency drops to 85 per cent (5.5 per cent). The overall cross-sectional dimensions range from 5 ft 4-11/16 in. high by 5 ft 2-½ in. wide for the 8330 cfm unit to 10 ft 4-11/16 in. high by 11 ft 1-3/4 in. wide for the 44,000 cfm unit. All are 8 ft long. Approximate net weight is 1970 lb for the smallest unit and 4800 for the largest.

38—FILTER REMOVES RADIOACTIVE PARTICLES

Cambridge Corp. is now ready to manufacture a filter that will remove radio-active particles from air. The units can be built to handle 1,000 cfm at pressures within the capacities of central station air conditioning systems. They will be particularly useful wherever air must be completely dust free or sterile, as in the manufacture and assembly of precision devices, biological laboratories or pharmaceutical plants. The filtering medium is a special soft and feltlike paper containing sub-microscopic asbestos fibers,

WILLIAMS-HAGER
flanged
Silent check
VALVES



Wherever Williams-Hager flanged Silent Check Valves are installed, plant maintenance men will tell you their costly water hammer troubles are over. These dependable, durable and compact valves can be placed in your water system in any position, including angular, and will provide maximum protection at all times. They are available for every service in standard pipe sizes from 1" to 20". Why not rid your plant of water hammer *now* . . . get Williams-Hager Check Valves.

Write today for Bulletin WH-100.

CHECK VALVES

THE WILLIAMS GAUGE CO.

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Steam Traps . . . Pump Governors . . . Feed Water Regulators . . . Water Columns

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which direct the air through tortuous paths. Large sheets of this paper are folded in accordion fashion and fitted into a frame, thereby providing a large filtering surface in a relatively small space.

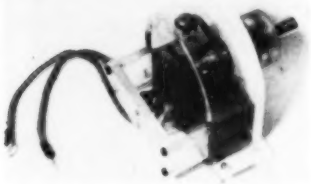
39—MEDIUM SOLENOID HAS 4 TO 10 PSI PULL

A solenoid, in the medium size range but with power sufficient for larger size applications, is announced by Practical Electric Co. that is available in three voltage ranges —110, 220, and 440—with $\frac{5}{8}$ in. maximum stroke. Pull or push ranging from 4 to 10 psi against gravity. Features are: (1) simplified construction, enabling complete disassembly for coil replacement without

removing solenoid from original mounting, (2) fan-proof laminations assembled by an exclusive electro-hydraulic forging process, (3) a "T" shaped armature provides high rating with half the impact when energized while producing a closed magnetic circuit devoid of air gaps, (4) low temperature operation because of small coil current required when closed and (5) shock-proof backstop for long life.

40—INTERLOCKING CONTROL HAS 2 TO 20,000 RPM RANGE

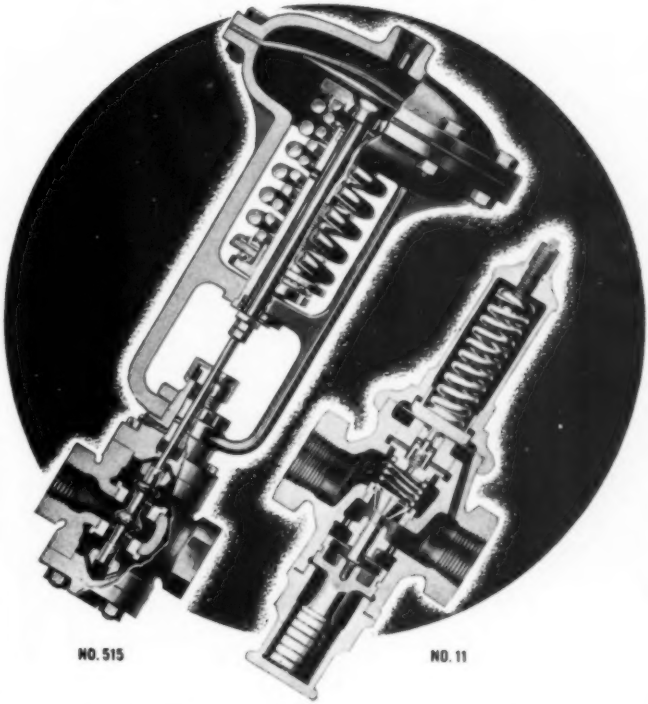
According to Walworth Controls Co. the use of a fluid coupling from the shaft to magnet actuating disc and magnetic coupling from disc to vane of mercury switch, an entirely new field of electrical interlocks has opened. As a means of indicating the running or stopping of the drive shaft, signalling the direction of rotation of the shaft, or impulsing electric counters for the number of rotations of the drive shaft in either



or both directions, this switch is recommended for use on conveyer idler pulleys, centrifuges and interlocks. All exposed metal parts are of stainless steel. The internal housing is of Plexiglas, and three ball bearings support the rotating members. The special mercury actuator is sealed in glass and is rated at $\frac{1}{2}$ amp at 125 v. This unit may be set to operate from 2 to 20,000 rpm.

FOR PREFERRED PERFORMANCE *without*

Paying Premium Prices . . . Use Masoneilan Pressure Regulators



NO. 515 NO. 11

You can depend on Masoneilan performance-proved reducing valves and pump pressure regulators to provide accurate control of steam pressures. Constructed of quality materials throughout, these regulators incorporate many cost-cutting features that assure long operating life with little if any maintenance.

No. 11—Initial pressures up to 250 lbs. reduced to any desired pressure between 5 and 75 lbs. or 75 and 225 lbs. Sizes ½" to 2" — bronze; 2½" to 4" — iron.

500 Series — Maximum working pressures from 125 lbs. at 350°F, to 250 lbs. at 450°F; pressure ranges ¾-3; 2-8; 6-25; 20-75; 60-160 lbs. Sizes ½" to 6".

MASON-NEILAN REGULATOR CO.

1191 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities:

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PACKET-TYPE *Automatic*
CONTINUOUS BLOWDOWN

- Prevents PRIMING
- Prevents FOAMING
- Prevents SLUDGE
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(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

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NON-FLUID OIL

TRADE MARK REGISTERED

Ideal for Ring-Oiling Motors

Nine out of ten short circuits are due to oil escaping from bearings and soaking windings. The result is a "burn-out."

The inherent characteristics of NON-FLUID OIL practically eliminate all oil-caused short circuits. It does not leak, creep or throw out of bearings. Motors run steadily with cool bearings and clean frames. You save money, too, because NON-FLUID OIL lasts longer and needs less frequent application.

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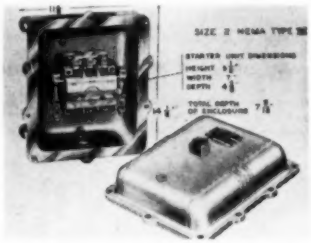
55th ANNIVERSARY NON-FLUID OIL

WAREHOUSES: Atlanta, Ga. • Birmingham, Ala. Charlotte, N. C. • Detroit, Mich. • Chicago, Ill. Columbus, Ga. • Greensboro, N. C. • Greenville, S. C. Providence, R. I. • St. Louis, Mo.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

41—MAGNETIC STARTERS ARE LIGHT AND COMPACT

The Arrow-Hart & Hegeman Electric Co. has announced a line of weatherproof magnetic starters that has a compact Feraloy cast housing. These motor controls are available in sizes 0, 1, 2, 3 and 4 for a wide variety of uses. This starter line is smaller

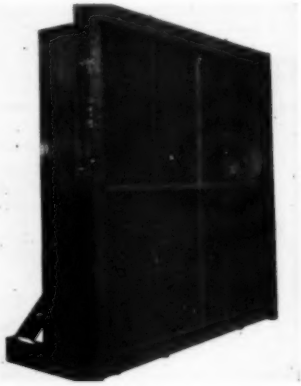


and lighter in weight. Features include straight-through wiring and ample working space for easy installations. Terminals are accessible from the front as are the contacts, which are simple to replace. Line and load may be completely separated and the circuits are immediately identified.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

42—COOLER HAS DOUBLE DUTY

Announcement has just been made by the Young Radiator Co. of an improved line of engine jacket water coolers. Every phase of design and construction of the units has been dedicated to making the units capable of withstanding the abuse of applications on portable equipment. Gas and lube oil cooling coils may be mounted between the fan and liquid cooling core. The blower-type fan cools the oil or gas first, with the mini-

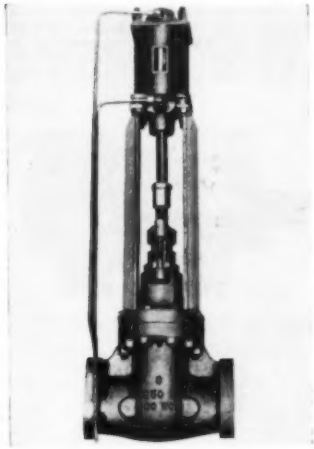


mum rise in air temperature, little affecting the cooling properties of the air flow over the liquid cooling core. This core arrangement makes possible a lower fan-horsepower requirement than the more conventional ar-

rangements. Vertical water flow, heavy formed steel channel side members, steel side supports for cores and press-formed heavy weight non-ferrous headers are said to provide a unit capable of resisting vibration.

43—ACTUATOR OPERATES MANY VALVE TYPES

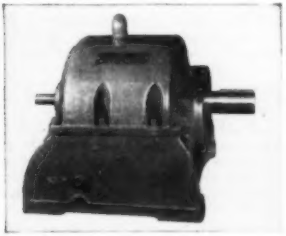
A line of valve actuators has been designed to operate gate valves, plug valves, dampers, diaphragm valves, butterfly valves and sluice gates, by Ledeen Mfg. Co. The actuators are basically cylinders, equipped with



brackets, valves, controls, and couplings to make them suitable for almost any type of operation required. They can be adapted to any make, size and type of valve; to operate against any line pressure and to work on any fluid medium with any pressure available. They can be arranged for on-and-off service or for positioning service.

44—SPEED REDUCERS FOR 1 TO 100 HP RANGE

Type DB double-reduction speed reducers, in ratings from 1 to 100 hp, are now available from Westinghouse Electric Corp. They are designed for applications on small to medium-size drives where the prime mover is coupled or belted to the gear unit. These speed reducers use all-external type helical gearing, arranged in a horizontal plane. When coupled to an electrical motor a



straightline drive results. Eight unit sizes are available; twelve standard gear ratios range from 6.25 to 58.3:1. Other features include: accurately hobbed single-helical gear-

WESTON *Readable* ALL-METAL THERMOMETERS

—AVAILABLE IN THESE 3 TYPES

STANDARD INDUSTRIAL THERMOMETERS

All-metal dial types with stainless steel stems, in straight and angle forms. Scale lengths 3"—6" and 9", with stems from 2½" to 72". Available as testing thermometers, and for general purpose and heavy duty service. Ranges from −100 to +1000°F. All-metal construction prevents breakage, assures dependable accuracy for longer periods.

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Combines the features of the all-metal indicating thermometer with an alarm or control device. Has adjustable contact arm mounted in the glass and bezel. Supplied to make contact on increasing or decreasing temperatures. Has positive magnetic type contacts. Contact rating . . . 100 ma at 110 volts a-c; 50 ma at 110 volts d-c. Stem lengths 2½" to 24".

MAX-MIN® THERMOMETERS

Equipped with a manually set red index which moves up or down scale with pointer, remaining at extreme temperature reached until reset. Thus one reading gives present temperature, and maximum or minimum reached since last reading. Available in scale lengths of 6" and 9"—stem lengths 2½" to 24".

Literature describing Weston all-metal, as well as electrical and glass thermometers, sent on request. WESTON Electrical Instrument Corporation, 605 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

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2. **Valve Stem Lubricator at no extra cost.**
3. **Over-Heat Protection at no extra cost.**

Reduce Costs—with this better type of self-acting temperature regulator. It prevents OVER-heating. Controls liquids or air, heating or cooling. Valve Sizes ¼ to 2" incl. Available without thermometer, sizes ¼ to 6".

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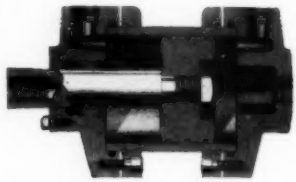
ing, taper hardened; split-construction cast iron case for accessibility; simple, positive splash lubrication system; antifriction bearings; and efficiencies averaging 96 per cent. Units are manufactured in accordance with recommended practices of the A.G.M.A.

45—HYDRAULIC CYLINDERS HAVE O-RINGS

Hydraulic cylinder whose covers may be rotated for any pipe connection and installation made in the minimum of space is now being offered by Rivett Lathe & Grinder, Inc. A modern keeper ring design is used to permit rotation of covers. External O-rings, instead of ordinary gaskets, are used as static seals to provide leak-proof operation. Sealing efficiency of the ring improves with increased pressure. Automotive type



rings are used on the piston to reduce friction to the minimum. Other features include: self-adjusting composition rod packing; ample bronze rod guide; over-size, ground and polished alloy piston rod; seamless drawn steel tubing, precision honed; and large pipe connections, providing ample cored or drilled passages.

46—REFRACTORY COATING GIVES HARD FINISH

The Power Chemicals Div. of E. F. Drew & Co., Inc. has announced the development of an improved type of refractory coating that dries to a diamond-hard finish. When dry, the coating practically becomes an integral part of the brick and contract uniformly with the brick under various heat conditions. Furthermore, it will not crack off or flake. Tests in the Drew laboratories and in actual operation have shown that the coating will prevent slagging, spalling, abrasion and disintegration of firebricks caused by combustion chemicals and high temperatures. Among the many advantages are: a smooth, hard surface, which results in greater reflection of heat; greater protection and longer life of firebricks; ease of application; and boilers may be fired immediately after application. This refractory coating is in liquid form and is as easy to apply as paint. It may be brushed on or sprayed. An application will provide long-lasting protection.

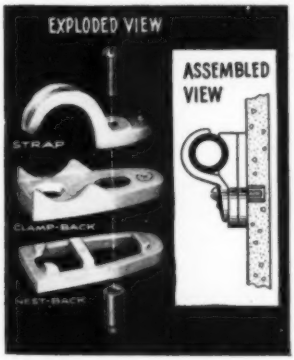
47—ELECTRICAL STEEL FOR HIGH INDUCTION

Thin electrical steel, developed by Armco Steel Corp., can be operated at very high inductions—20 per cent higher than any nickel-iron alloy. This material, thinner than most electrical steels, is intended for use in wound-type transformers and reactors, which operate at 400 cycles. It was developed under a contract with the Bureau of Aeronautics of the Navy Department to permit the miniaturization and reduction in weight of airborne electrical equipment. It not only has a marked advantage in the low

exciting current required at inductions over 16 kilogausses but also has a low core loss. Minimum permeability at 18 kilogausses is 1800. This value is not usually attained, even at only 14 kilogausses, by the best grades of non-oriented high silicon steel. The steel is an iron-silicon alloy with a high degree of orientation obtained by special processing and test-selection for high permeability requirements. It has a density of 7.65 grams per cu cm, a volume resistivity of 47 microhm-cm or 282 ohms-mil ft and a lamination factor of 95 per cent solid. Supplied in only 4-mil thicknesses and in $12\frac{3}{8}$ in. wide coils. Surface treated on both sides by a special chemical and thermal processing to insure low interlaminar energy losses. The surface treatment is unaffected by annealing. In addition to the unique electrical properties, it has excellent workability. The strip can be bent flat over a small radius then straightened without cracking, and can be easily slitted or sheared.

48—CLAMP OFFERS AMPLE WALL SPACE

Gedney Electric Co. has added a new fitting that makes strapping conduit even more versatile and efficient. Called the Gedney Nest Back it is a supplementary spacer, fits snugly under the clamp back and makes pos-

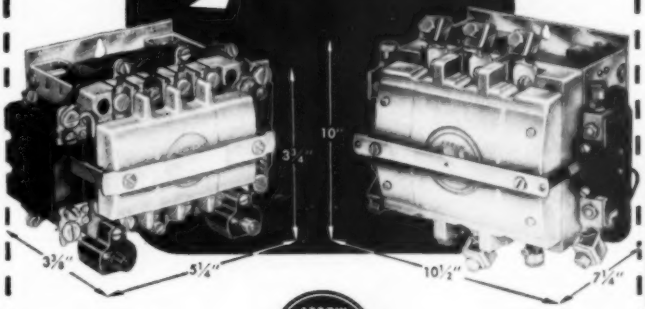


sible additional spacing away from the mounting surface. The parts fit securely into each other, and a conduit can be installed at any desired distance from the wall or ceiling. They are made of malleable iron, hot dip galvanized and come in a full range of sizes for rigid conduit and E.M.T.

49—CIRCUIT BREAKER FOR LOW VOLTAGE

A low-voltage air circuit breaker (DB-50) has been added to the line of DB breakers manufactured by the Westinghouse Electric Corp. that has an interrupting capacity of 50,000 amp. It features a completely new air-delayed series over-current tripping device, with all elements completely adjustable, that provides long-time delay on overloads and instantaneous tripping of fault currents. For use on feeder and back-up breakers, overcurrent trip units including both a long-time delay and short-time delay element can be specified, thus providing for selective operation on fault. It can be operated manually or by either d-c or a-c Rectox solenoid.

MORE BIG FEATURES IN JUST 1/2 THE SPACE



SIZE 0
ENCLOSURE DIMENSIONS:
6¹¹⁄₁₆" x 6⅜" x 3⅝"

ARROW AH HART

SIZE 4
ENCLOSURE DIMENSIONS:
19½" x 14½" x 8"

TYPE "RA"
MAGNETIC STARTERS

Whatever your requirements in a motor starter, you'll find the ***right*** unit to do the job ***better*** in the complete Arrow-Hart line, available in all sizes, 0-1-2-3-4. Straight-thru front wiring exclusive with A-H, means ***easy*** wiring, easy servicing, easy mounting. The patented A-H ***"RA" design*** cuts conventional starter size in half—***lets you step up motor size while reducing control size.*** Contacts are easy to reach and remove. All in all, Arrow-Hart Magnetic Starters give you more ***working advantages*** than any other controls on the market. Find out for yourself.

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Fully illustrated booklet complete with design and operating features, dimensions, ratings, catalog and parts numbers, etc., covering the complete "RA" line — Sizes 0-1-2-3-4 — yours on request.

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Fill up cracks, ruts, shallow holes, uneven spots, etc., in concrete floors with Smooth-On No. 7B Quick Floor Patch Cement. The patch will harden quickly, adhere strongly to an old floor, and is ready for use as soon as it is hard. Anyone can apply Smooth-On No. 7B by following the simple directions that come with it. The patches will stay tight, because Smooth-On No. 7B expands slightly as it hardens and wedges the patch securely in place. Order Smooth-On No. 7B Quick Floor Patch Cement in 1-, 5-, 20- or 100-lb. size.

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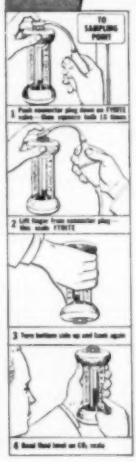

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Write for Leaflet 795

OXYGEN Indicator designed on same principle also available. Write for Leaflet 700.

BACHARACH INDUSTRIAL INSTRUMENT CO.
7000 BENNETT STREET—PITTSBURGH 8, PA.

NEW BULLETINS

(Continued from page 34)

235—Regulators & Valves. Catalog 51 contains 56 pages of illustrations and engineering data on steam and liquid control equipment. Drawings, layout diagrams, dimensions and capacity tables pertaining to pressure regulators, temperature regulators, float valves, water gages, float boxes, safety and relief valves, strainers, etc., are included. O. C. Keckley Co.

236—Control Centers. Economical, safe and convenient are some of the adjectives used describing centralized control centers in 4-page bulletin 4410. Informative booklet shows by words and pictures just what Multitrol units are; and why and how to use them. Gives specifications for typical Multitrol control center. Ward Leonard Electric Co.

237—Industrial Instruments. Here are 56 pages of the latest information on temperature and pressure instruments. Catalog 101-J contains complete data on industrial thermometers, hydrometers, pressure gages and regulators, and other products. Photos and drawings illustrate items. H. O. Trerice Co.

BULK HANDLING EQUIPMENT

238 — Magnetic Conveyer Elements. New principles in conveying skelp, plate, sheet, rod, bar pipe and shapes through installation of magnetic conveyer elements are illustrated and explained in 4-page bulletin 553. Gives varied applications and describes several typical installations. These include use on existing conveyers where single magnetic rolls are sufficient, and also where relatively narrow contour rolls of moderate magnetic traction are desirable. Types available, method of selection, and characteristics are listed. Eriez Manufacturing Co.

239—Tubular Conveyers. What they are; what they do; and how they're applied to move almost any flowable material — wet or dry — through any plane or angle is explained in illustrated bulletin. Lists applications and shows on-the-job photographs. Mentions manufacturing facilities along with other items produced by this company. Hapman-Dutton Co.

240 — Magnetic Separators. "Facts about Permanent Magnetic Separators" tells the purpose of magnetic separation and then proceeds to give you case studies in practically every industry. Another 8-page catalog, No. 12, discusses features and shows various models suitable for almost every application. Capacity and dimension tables are included as are diagrams showing how different types perform. Eriez Mfg. Co.

POWER TRANSMISSION

241—Roller Chains & Sprockets. Catalog RS-50 covers full line of roller chains and sprockets from stock. Provides complete specifications and engi-

Designed by *EXPERIENCE*... Proven by *SERVICE*

Fairbanks® *Micro-Control* Valves

150 lb. Bronze Globe Type

Fig. 0525 Bronze Globe Valve 150 lb. steam working pressure. Also available for 200 lb. and 300 lb. pressures.

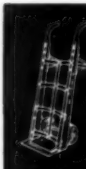
Fairbanks MICRO-CONTROL Bronze Globe Valves give you Needle Valve control and the durability of stainless steel. Here are the outstanding features of these Fig. 0525 Valves:

★Stainless Steel Plug Disc and Seat
Hardened to 500 Brinell, these parts resist corrosion, wire-drawing and abrasion due to solids in the fluid stream. The plug discs and seats are precision ground in *matched sets* to insure a perfect seal. These parts may be reground for long life.

★Two Piece Union Bonnet
Permits ready access to valve disc and seat for regrinding or replacement without removing the valve from the line.

★Radial Seat
The radial seat of the Union Bonnet, a Fairbanks feature, assures a tight body-bonnet joint and rigid alignment of all parts.

Fairbanks 0525 Bronze Globe Valves are a dependable combination of precision working parts and solidly built body... designed especially for close regulation of flow.



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ALKOR 5E-VITROBOND 120

Vitrified clay pipes when joined with a combination of Alkor 5E and Vitrobond 120 provides positive protection for your industrial waste lines. Send for Bulletin 2—30A.

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ZEROKS, AMPVARS, ALKALOY, DUVON

Atlas Protective Coatings offer a complete line of corrosion proof coatings. The corrosion protection of these coatings is intended for splash and fumes of industrial waste, within the limits of the corrosion resistant properties of each type. Send for Bulletin 7—1.

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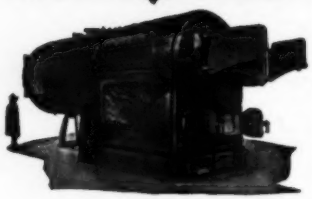

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Has all the characteristics which make firebox boilers ideal for high pressure. Complies fully with ASME and SBI codes.

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neering reference tables on American standard roller chains, sprockets and attachments. Dimensional data, strengths and weights are also supplied on allied products, such as block chain, cable chain and flexible couplings. Whitney Chain Co.

242—Speed Reducers. Bulletin A602B, 12 pages, illustrates and describes line of single reduction speed reducers. Lists advantages and gives construction data. Selection chart shows how to choose proper sizes for specific needs. Bore dimensions and bushing data are given in tabular form. Table of recommended V-belt drives included. Dodge Mfg. Co.

243—Adjustable-Speed Calender Drives. Bulletin GEA-5588 deals with adjustable-speed drives for calendering rubber, plastics and similar materials. Illustrated by nineteen photographs and a series of charts and diagrams, the 8-page booklet outlines the uses and advantages of the electronically-regulated drives. Includes dimensions and hp ratings of all G-E calender drive motors and motor-generator sets. General Electric Co.

244—Gear Coupling. Spline or gear type coupling designed to handle shaft misalignment up to 7 degrees is the subject of 6-page bulletin. Drawings and cutaway views show how the dihedral surfaces of gears provide maximum bearing area and handle maximum misalignment with minimum clearance on backlash. Selection table makes it easy to choose the correct size coupling. Recommended applications are listed and engineering service for special installations is offered. Ajax Flexible Coupling Co., Inc.

For more information use one of the convenient reply cards on page 117. No postage necessary. Insert the key numbers of items about which you want additional information mailed to you

245—Chain Drive Handbook. Helpful information for engineers and maintenance men is contained in new handbook and catalog. Packed with suggestions on how to install, maintain and operate roller chain. Tells how to plan chain drive layouts and offers hints on lubrication and roller chain selection. Also includes length conversion tables, hp rating charts, and specifications for all types of roller chain and extended pitch conveyor chain. Catalog ARC-51-PR. Atlas Chain & Manufacturing Co.

PUMPS AND ACCESSORIES

246—Pump Valves. Bulletin W-404-B4 covers Worthington's Rollo valves for viscous liquids and liquids with solids. Diagrams point out design advantages and photographs show the four component parts. Case histories bear out their claim for long wear and freeness from operating difficulties. Worthington Pump & Machinery Corp.

247—Packing Rings. Five types of self-sealing, self-adjusting packing rings are fully described in 4-page bulletin. Recommended by the manufacturer for use in valves, pumps and a long list of other

services. Bulletin lists conclusions drawn from test data. Contains drawings and diagrams along with engineering data and dimensions. Raybestos-Manhattan, Inc., Packing Div.

248—Packings and Gaskets. Comprehensive 100-page bulletin P-100 on R/M packings and gaskets makes it simple to choose and install the proper packing or gasket for efficient and successful operation of pumps, compressors, engines, etc. Various types and materials are arranged in convenient chapters along with charts, diagrams, cutaway views, drawings and photographs which should aid anyone concerned with packings. Raybestos-Manhattan, Inc., Packing Div.

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249—Horizontal Centrifugal Pumps. General utility Fluidyne pumps are the horizontal, end-suction centrifugal type and are available in a capacity range from 10 to 5500 gpm with heads to 260 ft. Bulletin B-2300 tells the whole story in 24-pages. Contains descriptive matter pertaining to features, application data, and construction details along with photographs, diagrams, tables and selection charts. Peerless Pump Div. Food Machinery Corp.

250—Centrifugal Pumps. Latest developments in a line of single stage, split case centrifugal pumps are covered in bulletin 5004-A. Pumps shown in 8-page booklet are furnished for direct connection to electric motors, steam turbine, gasoline engines, or with belt drive from any source of power. Vari-colored table simplifies pump selection to meet specific requirements for capacity and head. Capacities range from 25 to 4000 gpm with total heads from 20 to 300 ft. Illustrations of construction elements and detailed specifications including dimension tables are shown. The Deming Co.

251—Centrifugal Pumps. Pump and engine designed and built as integral unit is presented in 4-page bulletin. Gives actual test figures on various models along with specifications. Capacity to 160 gpm. W. S. Darley & Co.

TOOLS AND SPECIALTIES

252—Masonry Saw Blades. Practical, illustrated instructions on how to figure blade costs in masonry cutting before starting operations are contained in 24-page booklet. Tells how to know the correct blade to use on each different material in addition to how blades perform their cutting operation. Contains other factual information given in "how to" form. Everyready BrikSaw Co.

253—Industrial Vacuum Cleaners. In addition to conveying, collecting, reclaiming, sanitation, and water pick-up, over 100 other uses are claimed in Spencer's bulletin 125D. Photographs

2 BRONZE SEATS

No question about it, Darts are made to give extra value — much more for only a little more. Take the seats! They're both made of non-corroding bronze to give resilience and top resistance to corrosion and pitting.

A TRUE BALL JOINT

Then to give perfect contact — the wide-bearing area that locks out leaks — each is precision-machined. And, finally, spherically ground.

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The nut of a Dart — as well as both ends — is made from practically indestructible, high test, air-refined malleable iron. It's your guarantee of top resistance to stress, stretching and wrenching.

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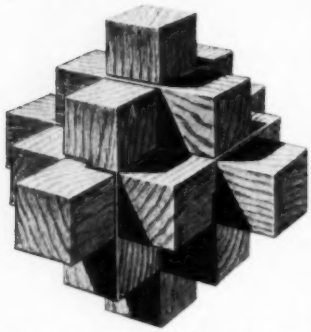

IN virtually every plant, all water problems are so complexly interwoven that no one of them can be solved without reference to the others.

Solutions of a sort may be relatively easy, but you want that specific group of inter-related procedures which—weighing results against investment, operating expense and maintenance cost—represent the most efficient and economic solution to the problems in *your* plant.

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BOILER WATER CONDITIONING • PROCUREMENT • TREATMENT • USAGE AND DISPOSAL OF INDUSTRIAL WATER

show how to use the various tools. Portable cleaners and stationary systems are illustrated and described. The Spencer Turbine Co.

254—Steel Castings. Intended primarily as a guide for engineers, 34-page illustrated booklet uses case history examples to demonstrate the versatility, strength and dependability of steel castings. Emphasis is put on economies of production, together with adaptability to complex design requirements. Lists seven reasons why virtually all types of manufacturing industries are making increased use of steel castings. Steel Founders' Society of America.

VALVES, PIPING AND FITTINGS

255—Piping Pointers. Helpful hints on the application and maintenance of piping equipment are contained in new edition of Crane's Piping Pointers manual. Covers the fundamentals of sound piping practices in non-technical language. Discusses various types of valve designs and how each should be used. Over half the 36-page booklet is devoted to "how to" features that are fully illustrated for easy understanding. Selection guide included. Crane Co.

256—Swing Check Valve. Full instructions on installation, operation and adjustment of cushioned swing check valves are contained in 4-page bulletin W-1. Gives general dimensions along with specifications and list of materials. Golden-Anderson Valve Specialty Co.

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257—Power Operated Valves. Colorful 44-page bulletin V-214, packed with piping, wiring, mounting, and installation data for pneumatic, hydraulic, and electric operated lubricated plug valves claims to be the first complete compilation of such data. Included are typical piping diagrams, arrangements for both side and top mounted motor controls, closing speeds, wiring data, and installation photos. According to the manual, use of power controls reduces operating costs, permits flow control from remote points, and makes timed-cycle operations easy. Rockwell Mfg. Co.

258—Nozzles, Welding Necks & Flanges. Anyone having a specific interest in pressure vessel work should avail themselves of this 72-page catalog 501. Describes a line of nozzles, welding necks and large diameter flanges. Contains a wealth of information pertaining to these products in addition to data covering TEMA Standards. Numerous tables, diagrams and charts are included along with installation and application photographs. Taylor Forge & Pipe Works.

259—Check Valves. Durable, compact, accessible, low friction—that's what 4-page bulletin WH100 says about flanged silent check valve. Cutaway views portray design and construction features, while on-the-job photos show the valves actually installed and operating. Chart for drilling bolt holes included. Available in all regular pipe sizes from 1 to 20 in., for all pressures up to 6000 lb and for any temperature. The Williams Gauge Co.

260—Corrosion Proof Linings. General bulletin MCC-1, 8 pages, describes complete line of chemical construction materials. Entire series of protective coatings including plastic as well as natural and synthetic rubber linings, cements, brick and tile sheathings is listed in tabular form. Contains a great deal of general information and refers to specific bulletins for additional details. Photos and diagrams show various applications. Atlas Mineral Products Co.

261—Welding End Specifications Table. Handy reference table, developed from specifications gathered from various sources contains, in addition to standard dimensions, diagrams of straight bevels for pipe wall thicknesses of ¾ in. and less. Also includes diagrams of U-bevels for pipe wall thicknesses over ¾ in. Edward Valves, Inc.

262—Valves. Catalog 104 gives a comprehensive picture of the current line of Edward cast and forged steel valves. The 28-page bulletin gives design detail, dimensional data and material specifications. Edward Valves, Inc.

263—Pipe Hangers—Sway Braces. Complete line of non-resonant variable-support hangers and sway braces are shown in 8-page catalog 502. Having damping features incorporated in their design, the supports cannot go into resonance with the supported piping, it is claimed. Booklet contains load-deflection charts, along with dimensions and components diagrams and tables. Bergen Genspring Corp.

264—Fluid Line Couplings. Advantages of standardizing are explained in 38-page catalog that covers quick-connective couplings for fluid line connections. Contains complete information, engineering data, dimensions, etc., on such types as straight-through, one-way shut-off, two-way shut-off, or special service couplings for steam, oxygen, acetylene, gasoline, etc. The Hansen Mfg. Co.

265—Expansion Joints. Bulletin 351 gives sizes, dimensions, suggested applications and other technical data on a variety of joints from small flexible connectors for use on diesel exhaust lines to 30-ft dia joints. Zallea Bros.

266—Stainless Tubing. Technical data are offered in 4-page bulletin 19. Gives condensed data on analyses, oxidation resistance, thermal treatment, and mechanical, electrical and physical properties on ten of the austenitic and ferritic stainless tubing steels. The Babcock & Wilcox Tube Co.

267—Duplex Tubing. The problem of inside and outside attack by two different types of corrosive media may be solved by using duplex tubing. Technical bulletin 1950 gives you 12 pages of

informative data on the application of duplex tubing in various industries. Methods of installing are described along with diagrams showing how it's done. Includes questionnaire to aid in deciding which metals should be used to combat double corrosion. Bridgeport Brass Co.

268—Hi-Temperature, Hi-Pressure Tubing Steels. Technical information valuable to engineers concerned with tubing used in elevated temperature and high pressure applications is contained in 6-page bulletin 12F. Contains such information as analyses, physical and mechanical properties, creep strength, short time elevated temperature tensile strength, and oxidation resistance of 14 of the more popular tubing steels. The Babcock & Wilcox Tube Company.

269—Corrosion-Resistant Fittings. Corrosion-resistant fittings are described in 8-page booklet. In addition to describing low cost fittings, for which patents are pending, the book shows how light-walled corrosion-resistant piping reduces the cost of a typical layout. Horace T. Potts Co.

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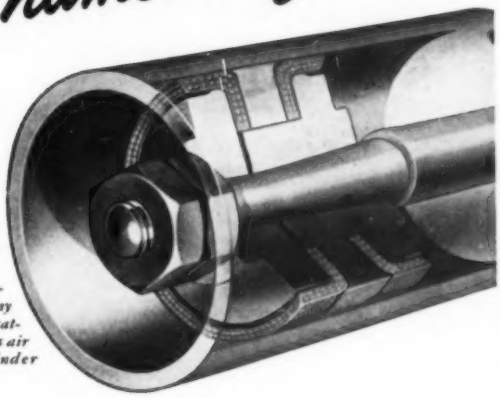
270—Revolving Joints. Rotary seals designed for steam or cold service, generally in excess of 25 to 50 rpm up to 2500 rpm in some models, are presented in Barco's 8-page catalog 300. General features, dimensions along with installation and lubrication suggestions are given. Includes diagrams illustrating typical installations for both the single flow and the syphon styles. Briefly describes flexible, swivel and swing joints and mentions catalogs covering these types. Barco Mfg. Co.

271—Manual Valves. Shut-off, selector and manipulator valves for pressures to 6000 psi are covered in 46-page catalog. Contains explanations and illustrations of the Shear-Seal principle. Included is simple outline for determining proper valve size with tables giving steel pipe data and capacities of hydraulic rams. Barksdale Valves.

272—Cast-Steel Alloys. Two comprehensive brochures describe cast steels and copper base alloys, which will help solve your piping problems and enable you to conserve critical materials by getting maximum service from your equipment. This new metallurgical information deals with the basic problems of metal soundness, porosity, welding, graphitization, creep strength, new alloys, code conformance and other subjects. It is the result of years of research. The Lunkenheimer Co.

273—Venturi-Ball Valve. Cardboard working model demonstrates unique action of venturi-ball valve. Said to provide accurate control at all positions from wide-open to tight-shut. Model also illustrates (1) straight-through flow with the valve wide open, (2) non-turbulent

You name the fluid...



Phantom cutaway showing typical Pumcup-piston assembly—one of many types for all reciprocating pumps as well as air or hydraulic cylinder mechanisms.

Here's how to pump it at lower cost!

IN thousands of plants, Darcova Pumcups are solving the problem of diminishing pump efficiency, repacking, maintenance, down-time, lost production—the things that really eat up dollars in fluid-handling operations! Here's why . . .

1. Darcova composition Pumcups not only increase volumetric efficiency, but they *keep* it high with no appreciable fluid slippage for the entire life of the Pumcups.
2. And, because of their design, composition, and operating principle, Pumcups have *many times the life* of most other types of piston packing.
3. Based on years of application research, Pumcups come in standard and special compositions for exceptional stability in handling almost *any* fluid you can name. For example . . . strong acids and alkalies, food products and even the most troublesome petroleum derivatives.

Big savings? We'll gladly refer you to Pumcup users whose problems are similar to yours. *They'll* tell you! Meanwhile, send for a free bulletin containing helpful, more detailed information: Bulletin 4401 on Pumcups for reciprocating pumps; Bulletin 4502 on Pumcups for air and hydraulic mechanisms. Just write to . . .

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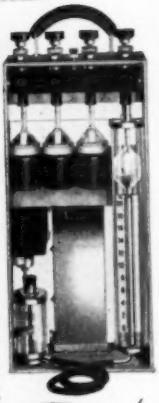

This ELLISON PORTABLE GAS ANALYZER gives you the **complete** story of flue gas content . . . accurate readings for CO_2, O_2 and CO-plus a flue gas thermometer. In one easy-to-handle case you have a gas sampling tube, pipe adapter, two flue gas thermometers, two thermometer holders, and portable draft gage sets for your particular needs. The case is made of chemical-resistant monel metal. Case bottom has four studs for standing the analyzer on flat surfaces. Be sure of proper combustion.

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Before you select a Temperature Regulator, compare low-cost Stacon with the rest. No other regulator has as many features or offers as many advantages as a Farris Stacon.

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Make this Chekchart Test

	Farris Stacon	Air Operated	Self Operated
• Dirt Proof — Hermetically Sealed?	Yes	.....	.....
• Extreme Accuracy?	±1°	.....	.....
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• Drop-tight Shut off?	Yes	.....	.....
• Vapor-stream Energized Super Power Pilot?	Yes	.....	.....
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THE LEAK-PROOF SEALER FOR GASKET AND PIPE JOINT CONNECTIONS!

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chatterless throttling, and (3) drop-tight dead-end shut-off. Paul Valve Corp.

274—Piping Engineer's Dimensional Data Card. Dimensions on welding fittings and flanges that could otherwise be found only by searching through many catalogs and tables have been condensed to page-size card. One side covers line of welding fittings. Shows wall thickness and the essential dimensions for all types of fittings from ½ through 30 in. Other side shows forged steel flanges. Dimensions and bolting data are given for all types and weights from ½ through 24 in. Other useful information for piping engineers also given. Taylor Forge & Pipe Works.

275—Automatic Valves. Automatic reseating relief valve, large size pressure-reducing and regulating valve are described along with a cross-section of entire line of valves suitable for industrial application. Great many changes in construction are discussed, having come about as the result of extensive research. Of particular interest is the information outlining the steps necessary to order pressure-reducing and regulating valves. A. W. Cash Valve Mfg. Corp.

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276—Steam Traps. Revised edition of "Solving Steam Trap Problems" contains 36-pages of helpful, practical information for engineers and maintenance men concerned with specifying, installing and servicing steam traps. Complete specifications and capacities on steam traps, float traps, air release valves and pipe line strainers are given. Describes how to calculate condensation loads and select traps for all classes of equipment. Gives pointers on how to install traps with the fewest fittings and how to service traps quickly and efficiently. Well illustrated with installation photographs and sketches showing typical arrangements, and construction. V. D. Anderson Co.

HEATING, VENTILATING AND AIR CONDITIONING

277—"Packaged" Precipitron. Westinghouse now offers electronic air cleaners in packaged units, according to 8-page bulletin DB93-820. Although not shipped in one piece, all parts are matched for sure fit and every necessary item is included. Booklet tells all the advantages and gives typical industrial applications. Construction features and typical specifications along with capacity and dimension table round out the two-color booklet. Westinghouse Electric Corp. Sturtevant Div.

278—Air Conditioning Equipment. Carefully selected list of equipment needed to do a job of air conditioning has been condensed into 16-page catalog SA-6692. Cooling, heating, dehumidifying, cleaning, filtering, circulating;

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to make
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Power is the stuff that makes the new ROTOJET stand out from all other tube cleaners. It makes tough jobs ridiculously easy. Uses less air, too. Get a powerful, rugged ROTOJET, and no other cleaner will ever satisfy you Air or water-driven models for practically any size straight or curved tubes.
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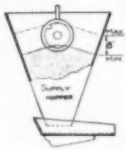
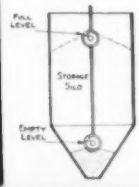
— nor too much too soon either. SYNTRON Hopper Level Switches maintain just the





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or ventilating; or air handling are all covered. Westinghouse Electric Corp., Sturtevant Div.

279—Freon Coolers. Freon or ammonia coolers of the dry expansion type are the subject of 12-page bulletin 101. Should be a valuable aid to those concerned with air conditioning, process, industrial and commercial refrigeration applications. Contains such valuable information as charts and tables showing cooling surface required for capacities from 2 to 232 tons of refrigeration at water flow rates from 15 to 575 gpm and for various baffle spacings in single and two-circuit designs. Also includes a log mean temperature table, cooler selection data, dimensions, pressure drops and typical piping arrangements. Patterson-Kelley Co.

280—Unit Heaters. Gas-fired unit heaters in sizes ranging from 70,000 to 230,000 Btu per hr are described in 30-page bulletin 7117. Gives design features along with application and installation instructions. Maintenance suggestions are conveniently placed with repair parts list. Six tables cover ratings, physical data, capacity of gas pipes, resistance of elbows, gas consumption of units, and drill sizes of orifices and burner ports. American Blower Corp.

281—Blowers. Low, medium and high capacity Standardaire blowers are covered in 6-page bulletin 88. Contains dimensional information including engineering layout, typical application data, design data, and rating—cfm at listed rpm. Drawing points out ten accessories and photos illustrate several models. The Standard Stoker Co.

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282—Space Heaters. Gas or oil direct-fired space heaters with outputs from 400,000 to 2,000,000 Btu per hr are presented in 8-page bulletin. Gives 30 reasons why Counterflo heaters are the least expensive and most efficient for open-space heating. Construction features, applications and installation data are included. Dravo Corp.

283—Industrial Air Conditioning Guide. Planning guide, in which all technical information has been reduced to understandable every-day terms, gives the whole story on industrial air conditioning. Explains the five vital functions a system should perform and tells you what to expect along with factors to consider when planning a system. Details and features of different types of equipment together with illustrations showing the units in operation are given. Booklet B-5160, 20 pages. Westinghouse Electric Corp. Sturtevant Div.

284—Dust Collectors. Dust is collected either to minimize a nuisance or for the value of the material collected. Bulletin 1428 gives you a picture story of the American Blower facilities for testing, designing and building dust collecting equipment. American Blower Corp.

285—Dust Recovery. Folder C-117 describes installations of equipment made in various dust-recovery applications. Although the bulletin particularly features applications in cement, stone and rock crushing plants, much of the data is also of interest to those in other industries where dust recovery problems are present. Weston Precipitation Corp.

MISCELLANEOUS

286—Custom Products. Catalog shows facilities for producing custom products to your specifications. Large tanks, boilers, heat exchangers, stacks, duct work, structural assemblies, hoppers, and pressure vessels are some of the items pictured and discussed. Hapman-Dutton Co.

287—Industrial Waste Incinerators. Efficient incinerators are recognized necessities for industrial plants. Catalog 35-J-41 gives you full description along with illustrations on extensive line of incinerators designed to burn any type of wet or dry waste. Includes tables which give capacities for standard sizes and models, in addition to survey sheet that enables Plibrico engineers to recommend types and sizes best suited to your needs. For existing incinerators there are three pages of information on such accessories as overfire air jet system, and castable refractory for lining stacks, flues and breechings. Plibrico Jointless Firebrick Co.

288—Heat Transfer Equipment. Condensed 4-page catalog 10 shows representative items in heat transfer equipment. Actually is an illustrated index of P-K equipment with catalog details offered. Patterson-Kelley Co., Inc.

289—Planned Lighting. Bulletin LD-4 is a comprehensive 47-page publication titled "Planned Lighting For Industry". Profusely illustrated, it outlines the benefits of good industrial lighting; then describes how to engineer lighting to various industrial tasks. Discusses six principal lighting systems and the use of specific techniques for special needs. Sections are devoted to protective lighting; wiring for the lighting system. General Electric Co.

290—Foundation Structures. Types and applications of foundation structures, pressure grouting, drainage, de-watering, shoring and sub-surface soil exploration are illustrated and described in 24-page brochure. Includes valuable tables prepared for the assistance of engineers in figuring drilled and poured foundation piling and caissons. Of particular interest are tables on volume of different diameter caisson bells in relation to various size shafts. Casey & Case Foundation Co.

291—Anti-Corrosive Paints. Full description of the technical properties of anti-corrosive paints is given in 8-page bulletin. Recommends specific types for a variety of applications. Shows how to apply paints; giving details on surface preparation, brush and spray applications, flow coating and drying time. Contains 2-page discussion on painting of galvanized structures. Subox, Inc.

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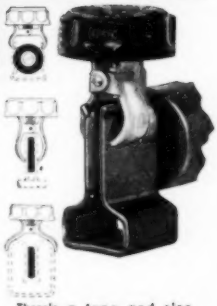

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Handy for Temporary connections.

Clamp flat or round objects. Carry heavy currents. Attached in a jiffy. 7 sizes 0 to 300 Amps.

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IT'S THE MERCURY SWITCH THAT DISTINGUISHES Mercoid FROM THE AVERAGE LINE OF CONTROLS

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Use durable INSTANT-USE . . . a tough plastic material which you simply shovel into hole—tamp—and run traffic over immediately. Tough INSTANT-USE is ideal for repairing cracks and breaks due to relocating machines . . . or for complete overlays. NOTE: Plasticizer makes INSTANT-USE easy to scoop out of container . . . easy to level, to tamp, to use! *There's a Flexrock material for every floor condition—oil, acid, wet, dry! Tell us your problem!*

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Please send me complete INSTANT-USE information details of TRIAL ORDER PLAN and HAND BOOK OF BUILDING MAINTENANCE—no obligation. (Clip and attach Coupon to Co. letterhead).

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Company .....

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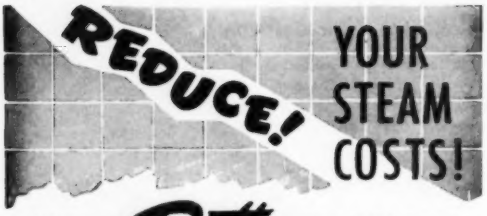
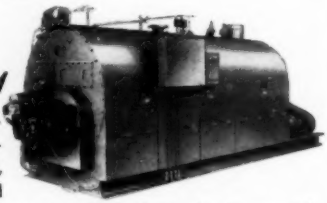


WITH A *Dutton* "PACKAGED"

STEAM GENERATOR

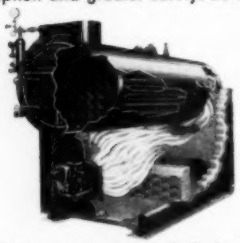
Dutton Steam Generators are QUALITY PRODUCTS, incorporating exclusive features of LONG LIFE, LOW OPERATING AND MAINTENANCE COST, MAXIMUM EFFICIENCY and SAFETY that only 71 years experience in boiler making can produce. Dutton Automatic "Packaged" Steam Generators are completely assembled – no special foundation or expensive chimney are needed.

Dutton EconoTHERM



Completely self-contained, automatically operated, 3-pass modified Scotch Internal Furnace type which gives twice the power in half the usual space. Features such as the Dutton Off-Center Firing and Rotary Combustion assure faster steam and more steam with less fuel consumption and greater safety. Burns gas or oil.

Dutton EconoMIST



A highly efficient horizontal return tube type, assembled in portable casing and ready for firing on arrival. Dutton improved shell design and double size full length, high bricked firebox, give faster steaming and longer steam carry-over with less fuel consumption. Burns oil, gas or coal with high efficiency – easily converted from one fuel to another. Available as a package unit with firing equipment, controls and mechanical draft with short stack.

Let us help select the best type for you.
Write for catalog IP-651 on "Packaged" STEAM GENERATORS.

Dutton BOILER DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO • MICHIGAN
Boiler Makers Since 1880

"SPOT" NEWS OF INDUSTRY

(Continued from page 110)

data for eight different types of stainless Croloys, covering physical and mechanical properties and processing data, are given.

Copies of the book, known as Technical Bulletin IB, are available free on request to the company at Beaver Falls, Pa.

A. S. T. M. Committee Will Formulate Methods for Atmospheric Sampling

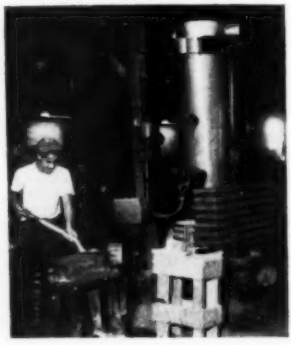
The American Society for Testing Materials has appointed a committee with Dr. L. C. McCabe, Chief, Air and Stream Pollution, U. S. Bureau of Mines, as chairman, to formulate methods for atmospheric sampling. In addition, the committee will work to stimulate research in the problem. Many problems are involved, but in authorizing the committee the society believed that its time-tested procedure of bringing together various technical viewpoints on intricate problems, might aid in achieving constructive results. The committee will not concern itself with the abatement of pollution, but only with standards for evaluating it.

Direct-Fired Space Heaters Improve Working Conditions at Large Foundry

Substantial improvements in plant working conditions during cold weather is reported by the Seaboard Foundry of Providence, R. I. because of five 550,000 Btu Thermobloc units installed last year. Fast morning heat up, uniform temperatures, and satisfactory working conditions throughout the plant are effected through the use of automatic controls.

Designed and manufactured by the Thermobloc Div. of Prat-Daniel Corp., Thermoblocs are made in five capacities from 100,000 to 1,000,000 Btu output, and are self-contained, direct-firing units that circulate heated air down at working levels. They require no complex piping, duct work or radiator installations, and are, therefore, easy to install and ready to operate simply by hooking up to a gas or oil line and a power line. Multiple installations to meet the exact requirements of any size plant are made possible by combining units of various sizes.

Thermoblocs are also being used widely for tempering make-up air, for high temperature recirculating ducts in drying systems, and as heat curtains for doorways. A tech-



Fast morning heat up, uniform temperatures and good working conditions are effected through use of automatic controls on the Thermobloc unit heaters installed in New England plant

nical bulletin to aid in estimating heat losses and requirements is available from the manufacturer at South Norwalk, Conn.

Connecticut Light and Power Co. To Install Four Gas-Turbine Units

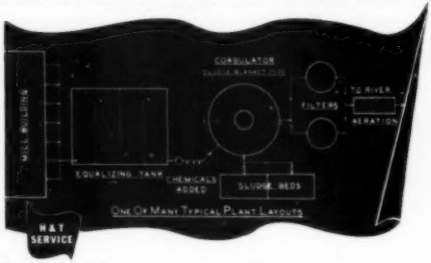
Four gas-turbine power plants, first to be installed in the state of Connecticut, will be placed in service early in 1953 by the Connecticut Electric Light and Power Co. The units will be built by General Electric at a shop in Schenectady, N.Y. that has been newly equipped at a cost in excess of $4,000,000 for the exclusive production of gas-turbine plants.

These four gas turbines, with a total capacity of over 20,000 kw, will be used for emergency standby power and for peak-load service because they can be brought from standstill to full load and "put on the line" in approximately 15 min.

In operation, according to G-E engineers, the unit takes in "outside" air and compresses it in two stages with an intercooler between the compressors. Each compressor is driven by a separate turbine, with the two turbines in the same casing. One turbine operates at constant speed, driving the 5,000 kw generator through reduction gears in addition to the high-pressure compressor. The second turbine is driven by the exhaust from the high-pressure turbine, and operates at varying speed with the amount of load, thus developing higher efficiencies proportionally under partial load conditions. The exhaust from the low-pressure tur-

(Continued on page 154)

HOW HUNGERFORD & TERRY TREATS INDUSTRIAL WASTE WATER PROBLEMS



1. Survey of flow rates, quantity of water, available equipment, space, pipe sizes, and other information.
2. Analysis of representative waste water samples, to determine the most efficient and economical treatment. A complete report on treatment and treatment cost is submitted.
3. Build model waste water treating unit from our laboratory findings. A quantity of waste water is passed through the model in the presence of plant representatives. Samples are analyzed to show treatment process.
4. A formal proposal is prepared and submitted with a schematic drawing to show operating arrangement and complete guarantees of EFFLUENT capacity and quality.
5. Work in close co-operation with all national, state and government authorities.

Write For More Information

HUNGERFORD & TERRY, INC.
Clayton 1, New Jersey

Now Burn SLUDGE Along with Fuel Oil!

HOUGHTON

HOUGHTO-SOLV

Keeps fuel oil sludge in permanent solution... makes it burnable...maintains clean heating system!

HOUGHTO-SOLV is the swift, sure way to remove sludge and make it pay. Records show savings as high as $2000 in one plant, in one operation. More than a billion gallons of fuel oil have been treated with Houghto-Solv!

You solve your sludge problems by adding as little as *one quart* of Houghto-Solv to each 1000 gallons of fuel oil. Sludge deposit is dissolved ... kept in suspension permanently ... actually burned along with the oil!

In developing this fast-acting fuel additive, Houghton research has come up with a sludge solvent that users say has everything! You utilize maximum BTU's. You keep your heating system running efficiently. You gain sizeable savings in oil.

We urge you to try Houghto-Solv, especially if you use heavier fuel oils. We will gladly send you a sample to test, along with further information. Mail coupon below to E. F. Houghton & Co., 303 W. Lehigh Avenue, Phila. 33, Pa.

DISSOLVES SLUDGE 10 TIMES FASTER!

TRY THIS TEST!

Houghto-Solv completely disperses sludge in 16 seconds in timed test.

Ordinary solvent tested *2 minutes* shows practically no results.

SEND FOR SAMPLE
MAIL COUPON TODAY!

E. F. HOUGHTON & CO.
303 W. Lehigh Ave., Philadelphia 33, Pa.
Without cost to us, please send:
☐ Prices and full information on Houghto-Solv.
☐ Sample of Houghto-Solv for making simple test.

Name_____
Company_____
Address_____
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Ready to give you on-the-job service ...

When the Process Demands
CLEAN, DRY AIR
at constant pressure for

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- Industrial activated sludge waste disposal systems
- Agitation of industrial acid neutralization systems
- Oxidation of industrial wastes for disposal
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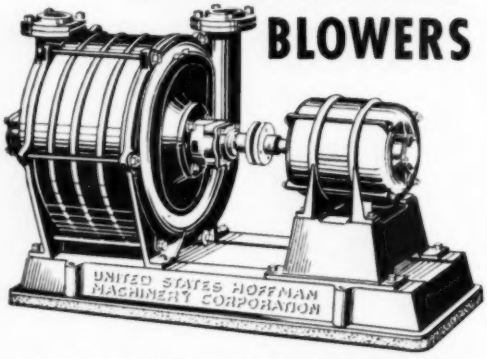
MULTISTAGE CENTRIFUGAL
BLOWERS



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Built for heavy-duty, continuous service . . . no internal moving parts, no internal lubrication to contaminate air. The standard for a variety of applications in paper mills, plating works, steel mills, textile mills, canneries, rubber plants, chemical works and auto plants. Models for a wide range of pressures and volume, for air or gas. Write for Free Bulletin A-650.

HOFFMAN ALSO BUILDS HEAVY-DUTY INDUSTRIAL VACUUM CLEANING EQUIPMENT IN STATIONARY AND PORTABLE TYPES. *Write for Bulletins*

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CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO. LTD. NEWMARKET ONT.

bine passes through a regenerator to heat the incoming air from the high-pressure compressor before mixing with fuel in the combustion chamber where the air is still further heated to the design turbine inlet temperature of 1500 F.

New Periodical Is Devoted To Developments in Dust and Fume Control

The first issue of "Industrial Ventilation", a new periodical devoted to the latest developments in industrial dust and fume control, has just been published by American Wheelabrator & Equipment Corp., Mishawaka, Indiana. This issue contains illustrated case histories on the application of Dustube cloth-tube filters to dust control problems in various industries. Of special interest to ventilation engineers is the informative technical discussion on the collecting efficiencies of cloth-type filters. To get on the mailing list for copies of this publication, write to the American Wheelabrator & Equipment Corp., 555 S. Byrkit St., Mishawaka, Ind.

Unusual Service Offered To Users Of Industrial Batteries

Gould-National Batteries, Inc., recently announced its "Plus-Performance Plan" devised to help industrial battery users get more production and greater performance from their storage battery equipment.

The plan consists of an integrated conservation program based on applicable charts, manuals, and articles pertaining to particular users' problems. It operates as follows:

The battery user simply addresses a request to Gould-National Batteries, Inc., Trenton 7, N. J., stating two things: (1) the kind of battery service in which he is interested, such as diesel engine starting, utility service, emergency lighting, etc., and (2) the points on which he desires information. Upon receipt of the request special individualized portfolios will be made up covering the technical information desired in the indicated field of battery use.

Included in the portfolio may be reprints of engineering articles from leading trade magazines, instruction manuals, specification data with discharge curves, bulletins covering battery construction, charging charts, sets of sample record cards, etc. The prepared folio, which constitutes a reference file on the subject covered, will be promptly forwarded, without obligation, to the inquirer. Should specific questions be asked concerning special problems, Gould's engineering staff will prepare and forward an individualized study and recommendations. Finally, a request on a special field problem will bring Gould engineers to inspect batteries without obligation.

Small Blast Furnace Recovers Manganese From Steelmaking Waste

A miniature blast furnace at Pittsburgh, working with slag, the waste material of steel production, may prove to be one of the most important furnaces in the country, according to American Iron and Steel Institute. This furnace, 16 feet high, started operating early in March in an attempt to recover the manganese in slag from openhearth furnaces.

Research on manganese, an essential element in steelmaking, has been intensive in recent months to avert possible domestsic shortage if foreign sources of supply are drastically reduced. Some resesarch metallurgists believe that an estimated 440,000 tons a year of manganese may be found in this country in economically recoverable openhearth slag. That tonnage is equal to approximately 68 per cent of the amount used in steel manufacturing during 1950.

CLASSIFIED ADVERTISING

FOR SALE

FOR SALE—One 300 K.W. Steam Turbine and G.E. Generator. 600 Volts, Type ATB

THE RANDOLPH MILLS, INC.
Franklinville, N. C.

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11 Westinghouse, 300 KW, 120/230 V., D.C. Generators, Baldwin Diesel Driven

230 Volt, D.C. Motors:
20 Westinghouse, 50 H. P., 600 RPM
20 G. E., 50 H. P., 525 RPM
1 Westinghouse, 90 H. P., 575 RPM
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GLOVES
COTTONS — RUBBERIZED
LEATHERS — PLASTIC — ETC.
All Types — For All Industrial Uses
"Special Gloves for Special Jobs"
Immediate Delivery
Samples and prices furnished on request.

H. & R. Company
366 Wacouta — St. Paul, Minn.

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1 Steam Engine, Vitter Mfg. Co., Milwaukee, Wis., Rolling Mill Type Corliss horizontal simplex Steam Engine. 29" cyl., 42" stroke. Serial No. 124753. Heavy duty, 350 H.P. (90-120 RPM, now set at 96). Direct shaft drive. Fly-ball governor-outboard bearing, with 1-14' dia. x 46" and 1-10' dia. x 18" flywheel and necessary belting. Interested parties write Box 6A c/o this publication.

FAIRBANKS, MORSE DIESEL GENERATING UNIT

Model 32E14 300 HP., 300 RPM Diesel with a direct connected 200 KW alternator and exciter. Voltage 2400.

This unit will soon be replaced with a larger one. It may be seen in operation at the Municipal Light Plant. For particulars contact the City Clerk.

CITY OF FARMER CITY
Farmer City, Illinois

HELP WANTED

STEAM GENERATOR SALES MANAGER.

Chicago, no traveling. Adequate salary and incentive bonus. Write, stating previous experience, for interview. Our men know of this ad. TEMPERATURE EQUIPMENT CORP., 816 N. Kostner Ave., Chicago 51, Ill.

PROFESSIONAL SERVICES

PAUL H. MORRISON
Water Consultant and Chemist

Referee and consulting — industrial wastes, water supplies, purification, pollution, feed and boiler water control.

Reagents, test kits, water-conditiong equipment.
— 25 years specialization —

Valencia, Penna.

POSITION WANTED

ATTENTION MANUFACTURERS

INDUSTRIAL EXECUTIVE — 43, available — 23 years experience — industrial engineering, plant management, labor relations, sales in metal fabrication, pressure vessels, package boilers, heating equipment, etc. Excellent record and references. Write: Box 6B

INDUSTRY AND POWER, St. Joseph, Mich.

AVAILABLE REPRINTS

THE AMERICAN CYANAMID STORY: While our limited supply lasts, you can obtain additional copies of the popular January, 1951 issue of INDUSTRY AND POWER at only 50¢ per copy. This issue contains the complete report on Plant Engineering Group activities at American Cyanamid Company. This is an exclusive fifty-two page report of outstanding significance to every engineer and plant executive. Extreme care had been used to present only factual, tested data—in simplified yet detailed form —so it can be adapted and put to work by the Plant Engineering Group in **your** plant. Includes articles on Water: Supply, Utilization and Conservation; Waste Disposal; Outside Air Pollution; Long Range Planning for Future Expansion; Materials of Construction; Instrumentation; Power Generation and Distribution; Lubrication; Maintenance; Power Transmission; and many, many more top-interest subjects. These extra copies were originally offered for sale at $1 per copy—now, while our stock lasts, you can buy the additional copies you need for individual use and reference of others in your Plant Engineering Group at only 50¢ per copy. Order from Reader Service Dept., INDUSTRY AND POWER, St. Joseph, Mich.

We also have a few copies of the following article reprints which are available to you free of charge:

"Boiler Houses Are Not Necessary Evils", February, 1950.
"Correct Plans Consider Future Expansion Too", December, 1950.
"Filters . . . What They Are, How and Why They Are Applied", February, 1951.
"Grievances Can Be Avoided", April, 1950.
"Harbor Plant Pioneers in Pneumatic Build-Up Refractory", December, 1950.
"How To Select Corrugated Expansion Joints", June, 1950.
"Know Your Fuses", March, 1951.
"Low Cost Auxiliary Power From Turbine Drives", April, 1950.
"Monsanto Builds Ideal Process Steam Plant at Everett, Mass.", June, 1950.
"Proper Water Tower Means Water Conservation", March and April, 1951.
"Qualifications of an Industrial Supervisor", June, 1949.
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"Steam, Air, and Power for 3 New Ford Assembly Plants", May, 1949.
"Supervisor's Personal Check-Up Chart", November, 1949.
"Synchronous Motors Do Two Jobs at One Time", February, 1950.
"Television . . . The Eyes of Industrial Control", Dec., 1950.
"Trigonometric Calculations — I and II", April, 1951.
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How to select and use fuels and fuel combustion equipment

THIS handbook presents comprehensive data covering the full range of commercial fuels and their combustion. It gives plant chiefs, testing engineers, plant equipment sales engineers, plant and plant equipment designers, etc., practical aid in determining the fuels and fuel combustion apparatus which can be used most efficiently for specific purposes. Supplying hundreds of tables, figures, graphs, and charts, the book serves as a ready reference not only on the properties, characteristics, and uses of all types of fuels but also on such corollary factors as heat balances, smoke prevention, and draft requirements. Its 915 pages contain a wealth of information about fuels and fuel combustion equipment for the experienced engineer, yet give instructions for firing and operating equipment that the boiler room operator will understand.

Just Out

FUELS AND COMBUSTION HANDBOOK

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915 pages, 6 x 9, 410 illustrations, 461 tables and charts, $12.50

Look up the helpful facts given on such topics as:

- ASME boiler test code
- analyses of propane
- heat values of lignite char
- heat content of asphalt
- air-mixing equipment for atomization of coal
- flammability limits of benzine
- boiling points of petroleum oils
- boiler ratings of British thermal units
- combustion ratio of butane
- measuring of chimneys
- errors in analyses of coal
- conductivity of metals
- draft required by fuels
- time-pressure data on dust
- costs of electric generation, broken down by plant size
- possible new sources of energy

In this one authoritative handbook you can look up the information needed to solve problems related to fuels and the way they are applied in combustion processes. In it you will find helpful data on a wide variety of combustion problems—from determining the fuel that will work most effectively on a particular job, or selecting the most efficient machine for a specific purpose—to computing heat balances, or devising a means of storing a gaseous fuel.

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INDUSTRY AND POWER
Reader's Service Department, St. Joseph, Michigan

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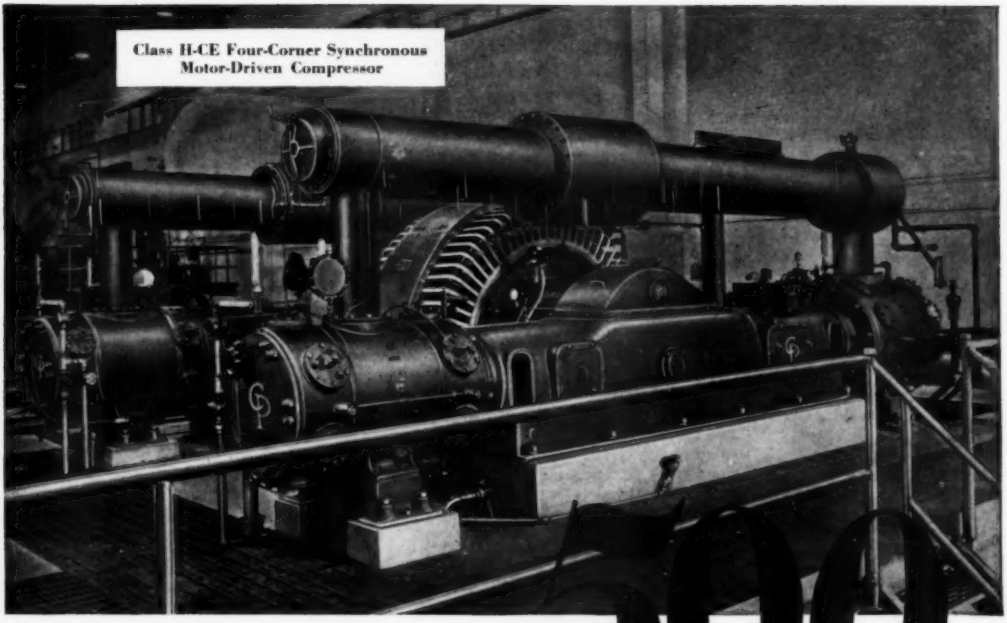

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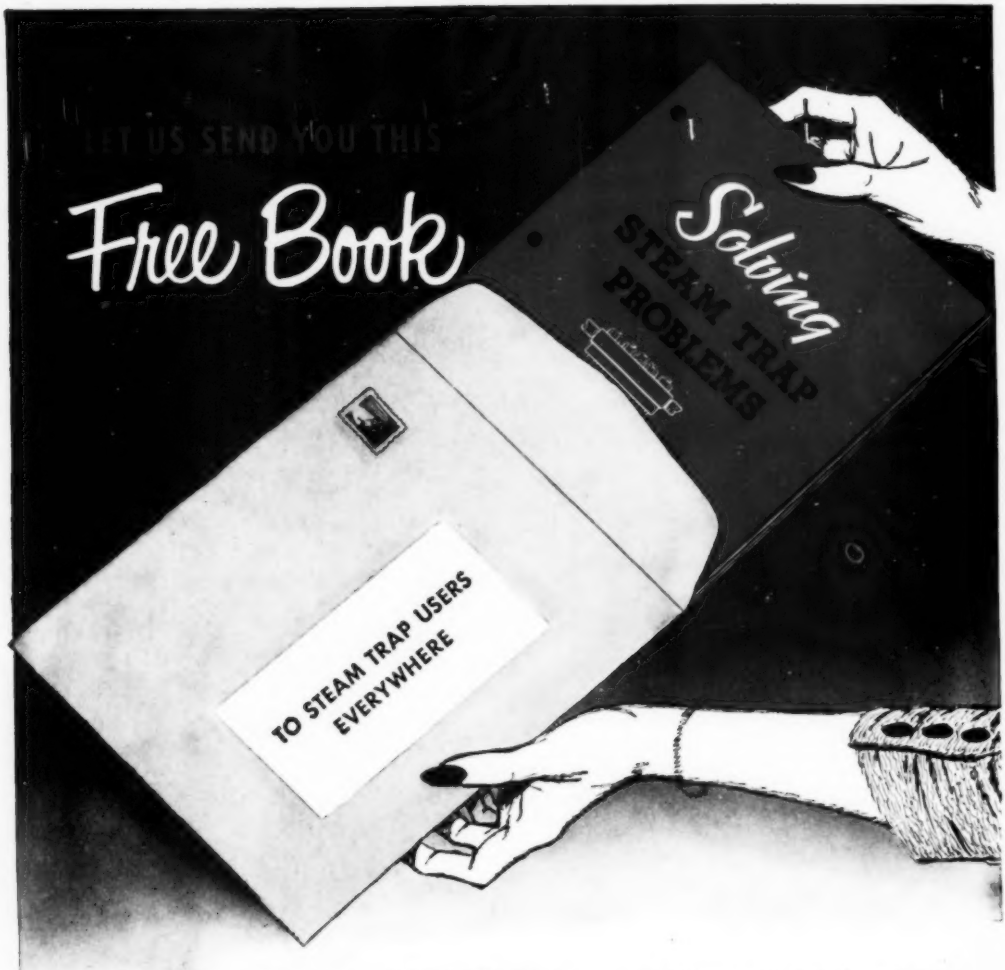

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